Has Thailand's Fertility Decline Stalled?

New data show that continued low fertility may be expected for some time to come

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Probably the most important demographic development to occur during the last quarter century has been the onset of fertility decline in a number of third world countries. While most Sub-Saharan African countries as well as a number in the Middle East and West Asia have yet to participate in this phenomenon, fertility in countries elsewhere in Asia and in much of Latin America has started down a path towards levels far lower than have ever prevailed in their modern histories. Given that mortality declines preceded the fall in fertility, and that most of these populations have been experiencing

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unprecedented rapid population growth rates at levels that would lead to extraordinary numbers of people in just decades, most observers concerned with population matters view the onset of fertility decline as a logical and welcome development.

In its broadest outline, the changes in many of the current third world countries can be seen as conforming to the pattern typically referred to as the demographic transition, i.e. the shift from a rough balance of high mortality and high fertility to a rough balance of low mortality and low fertility.

This process is already close to completion in most of the more developed countries of the world where fertility is generally below the replacement level and population growth is slow or even negative. The demographic history of the more developed countries suggests that, once begun, the secular decline in fertility associated with the demographic transition is typically continuous and ceases only after far lower levels than previously experienced are reached (van de Walle and Knodel, 1980). It is already clear that the pace of the fertility and mortality declines currently taking place in the third world is usually considerably faster than that experienced many decades earlier in the more developed world. Whether fertility declines will follow the largely continuous and irreversible process that previously characterized the demographic transition remains to be seen and is an interesting empirical question for investigation.

Concern has already been expressed by some observers about what appear to be stalls in the fertility declines of a number of developing countries and even a possible levelling off of fertility well above the replacement level. When viewed with a longer historical perspective in mind, a stall of a few years or even a few decades may seem insignificant. Nevertheless, such stalls can have substantial implications for population size at any given point in time in the foreseeable future, especially when a considerable gap between birth and death rates still exists.

Of special interest, therefore, are not only countries which have yet to embark on a fertility decline, but also those in which the fertility decline has apparently stalled. One study commissioned by the World Bank has already been completed; it focuses on apparent fertility stalls in Costa Rica, the Republic of Korea and Sri Lanka (Gendell, 1984). In addition, the issue of retardation of fertility decline was one of the major topics addressed in a recent IUSSP (International Union for the Scientific Study of Population) seminar on the fertility transition in Asia.[1/]

Fertility trends in Thailand

Thailand is one of the third world countries where a very substantial fertility decline has occurred during the last two decades (Knodel, Chamra-

trithirong and Debavalya, 1987). However, there has been some recent concern that the fertility decline in Thailand may have lost momentum at a level well above replacement fertility. Bongaarts (1987) includes Thailand in a list of developing countries where fertility declines have at least temporarily decelerated or plateaued.

The impression that Thailand's fertility decline has stalled stems primarily from information on fertility rates derived from the influential series of three national contraceptive prevalence surveys (CPS1, CPS2 and CPS3) conducted in 1978/79, 1981 and 1984. Fertility rates from these surveys are presented in table 1 together with results from the earlier Survey of Fertility in Thailand (SOFT), conducted in 1975 as part of the World Fertility Survey programme. Both total fertility rates and age-standardized general marital fertility rates are presented. It is useful to standardize the general marital fertility rate by age in order to eliminate the influence of differences in the age distributions of the samples. Based on fertility rates for the 12 months preceding each survey, it is evident that the fertility rates derived from SOFT are

Table 1: Fertility rates based on the Survey of Fertility in Thailand (SOFT) and three contraceptive prevalence surveys (CPS)

		Total fertility rate		Age-standardized general marital fertility rate	
Survey	**Year of survey**	**12 months prior to survey**	**24 months prior to survey**	**12 months prior to survey**	**24 months prior to survey**
SOFT	1975	4.50	4.21	223	206
CPS1	1978/79	3.77*	–	172*	–
CPS2	1981	3.68	–	186	–
CPS3	1984	3.47	3.36	183	173

Notes: The age-standardized general marital fertility rate is calculated by multiplying the age-specific marital fertility rates for each five-year age group of women by the proportional age distribution of currently married women aged 15-44 years as recorded in the 1970 census. The total fertility rates from SOFT represent revised figures and thus differ slightly from previously published estimates.

* = Excluding the provincial urban population.

Sources: Knodel, Chamratrithirong and Debavalya, 1987; Knodel *et al.*, 1982; Kamnuansilpa and Chamratrithirong, 1985 ; and Thailand Demographic and Health Survey.

clearly higher than those of the later contraceptive prevalence surveys but that only a very modest decline in the total fertility rate and a rise in marital fertility is indicated during the period spanned by the CPS series.[2/]

New evidence is now available from a more recent national survey, the Thailand Demographic and Health Survey (TDHS) conducted in 1987, which permits calculation of retrospective fertility trends and clearly contradicts the suggestion of a stall in the fertility decline during the period covered by the contraceptive prevalence surveys. In addition, data from national vital registration, while presumably incomplete, likewise show a clear trend of continuously declining fertility during this period. In addition, indirect indicators of fertility and rising levels of contraceptive prevalence based on a variety of national surveys, including the contraceptive prevalence surveys themselves, all suggest a continuing decline in fertility during the period in question and indeed since the onset of fertility decline sometime in the 1960s. This article reviews this evidence in detail, and presents data on family size preferences and expectations as well as gender preferences, and discusses their implications for future fertility trends in Thailand.

Complete birth histories were collected in the TDHS for each respondent as well as information on the number of additional children wanted and the preferred total number of children. One innovative feature of the TDHS with respect to eliciting birth history was to ask respondents to show documentary evidence in the form of birth certificates or household registration forms in order to improve the accuracy and completeness of the reporting of birth dates by reducing reliance on the respondent's memory for such information. Respondents were able to provide documentation of the birth dates for about half (52 per cent) of all the births reported and this percentage does not vary greatly according to the birth year.

Although the TDHS collected birth histories only from ever-married women, it is possible to calculate fertility measures relating to all women regardless of marital status by assuming that women who were reported as having never married had no children.[3/] To the extent that non-marital fertility is missed by the survey, however, the assumption of no births to women reported as unmarried will necessarily result in an underestimate of the level of fertility. While some births undoubtedly occur outside of marital unions, most observers agree that the level of non-marital fertility is likely to be quite low (Knodel *et al.*, 1982). Moreover, if at the time of the survey an unmarried women was living with her child in a sample household, she might well have been reported as married in the course of eliciting the household listing and may have been included as an eligible respondent.

With data on complete birth histories for women in the reproductive

ages, such as collected in the TDHS, it is possible to calculate retrospective trends in fertility provided some adjustment is made for the fact that the data for women at the older end of the reproductive age span are progressively censored the further into the past is the year to which the rate refers. This problem arises because only women currently of reproductive age at the time of the survey were interviewed. Thus, for example, fertility rates for women 40-49 years of age 10 years prior to the survey, and thus aged 50-59 at the time of the survey, can not be determined directly from the birth histories, since those women were not interviewed. In order to calculate the trend in fertility, as measured by the total fertility rate based on the TDHS, adjustments have been made to allow for this effect of censoring of fertility rates at older ages.[4/]

Total fertility rates for 1978 through 1986 based on the TDHS are presented in table 2 together with corresponding rates based on vital regis-

Table 2: Total fertility rates based on the Thailand Demographic and Health Survey (TDHS) and uncorrected registration data

	TDHS*	Uncorrected registration**
1977	3.53	3.41
1978	3.21	3.15
1979	3.40	3.11
1980	3.21	2.97
1981	2.94	2.81
1982	2.81	2.76
1983	2.52	2.64
1984	2.33	2.30
1985	2.31	2.25
1986	2.21	2.12

Notes: * = The TDHS rates are two-year moving averages covering a 24-month period centred approximately on April of the year shown. See text and associated footnote for explanation of estimation procedures used to compensate for the progressive censoring of rates at the oldest age groups as the time period covered extends further into the past from the time of the survey.

** = Based on the uncorrected number of births by age of mother as reported by the Ministry of Public Health and the estimated age distribution of women from official projections.

Sources: Thailand Demographic and Health Survey; Knodel, Chamratrithirong and Debavalya, 1987; and additional calculations based on birth registration data provided by the Health Statistics Division of the Ministry of Public Health.

tration data. Clearly no sustained stall in the decline between 1978 and 1983, the period to which the fertility rates from the contraceptive prevalence surveys refer, is evident from either source.

Although the rates based on registration data are uncorrected for under-registration, the trend would be affected only if the degree of under-registration were changing, and a spurious decline would be indicated only if registration were becoming less complete. The trends from both sources indicate a continuous decline throughout the period covered, with the minor exception of a temporary rise in the 1979 rate based on the TDHS.

One striking feature of the TDHS results is the very low level of recent fertility indicated. The total fertility rate (TFR) of 2.21, indicated for 1986 but which refers actually to the 24-month period preceding the survey (since results in table 2 are two-year moving averages), is just about at replacement level for Thailand, given the current mortality conditions. Indeed, the fertility rates revealed in the TDHS are low in comparison with other estimates of recent fertility levels, not only from the most recent Contraceptive Prevalence Survey (CPS3) but also from the Survey of Population Change (SPC), a large-scale survey employing a "dual record system" methodology.

The most recent SPC estimates a TFR of 2.73 for the period spanning mid-1985 to mid-1986 which, while considerably lower than the 1984 CPS3 rates, is still noticeably higher than the TDHS rates. This factor raises the possibility that the TDHS understates the true fertility level.

The large discrepancy between the CPS3 and TDHS estimates is likely to be attributable, at least in part, to differences in survey methodology. A policy followed during CPS3 fieldwork, but not in the TDHS, permitted substitution of originally selected sample households when nobody was found at home despite the interviewers having made repeated visits. If, as a result of being able to substitute sample households in such instances, the interviewers were less persistent in their attempts to reach an originally targeted household when nobody was home, such a policy could conceivably lead to a disproportionate selection of households in which a recent birth had occurred.

A recent birth to a woman in a household would make it likely that someone would be at home, especially during the daytime, to care for the young infant. As a result, the CPS3 fertility rates could be inflated. Unfortunately, no information is available on the extent to which substitution actually occurred and thus the potential effect it might have had cannot be estimated.[5/] The policy of permitting substitution, however, would not explain why fertility estimates from the CPS series fail to show declining fertility,

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unless monitoring of the interviewers' persistence in attempting to contact households with no one initially at home deteriorated over the series.

Perhaps the most compelling evidence that the recent levels of fertility may be higher than indicated from the TDHS is that the TFRs calculated from registered births, as reported by the Ministry of Public Health without any adjustment for under-registration, are quite close to those indicated by the TDHS. For example, for the five-year calendar period from 1982 to 1986, the TFR as indicated by TDHS is only 1 per cent higher than the TFR based on registered births unadjusted for under-registration, Although the extent of under-registration is debatable, it is generally acknowledged that registration of births is incomplete.[6/]

While it is not possible to draw a definitive conclusion about the accuracy of the fertility estimates from the TDHS, they may underestimate the true level to some unknown extent. However, there is no obvious reason why an underestimation of levels would necessarily effect the trend shown. Moreover, previous impressions of considerably higher recent fertility, based largely on CPS3 results, were probably exaggerated.

A more complete representation of the trends in fertility indicated by the TDHS is presented graphically in the figure on the opposite page, which shows the trend in the TFR (based on the TDHS) over the last decade and a half and compares the trend with those based on data from SOFT, estimates based on the "own children" technique as applied to the 1980 census, and uncorrected registration data (in combination with population estimates of the base population). Also shown are the estimated TFRs from the second and third SPCs referring to 1974-1976 and 1985-1986, respectively.

The results from the TDHS clearly indicate a substantial and relatively steady decline in fertility over the last decade and a half. In addition, the different sources are quite consistent in portraying a more or less steady fertility decline over the last two decades. The series from TDHS fits quite well with the series from SOFT, both in terms of overlapping fairly closely for the several years shown in common and in continuing the trend of decline evident in the earlier SOFT series. However, while both the SOFT and the TDHS series data are quite parallel to the "own children" estimates from the 1980 census, they both generally fall below the latter estimates. In addition, the 1974-1976 estimate from the SPC, while relatively consistent with the "own children" rates, is higher than both the SOFT and TDHS trend lines and the 1985-1986 SPC estimate is above the equivalent TDHS rate. Quite possibly, fertility rates from SOFT and TDHS, which in both cases are derived from retrospectively collected birth histories from ever-married women, underestimate fertility

Figure: Trends in the total fertility rate, selected sources, 1960-1986

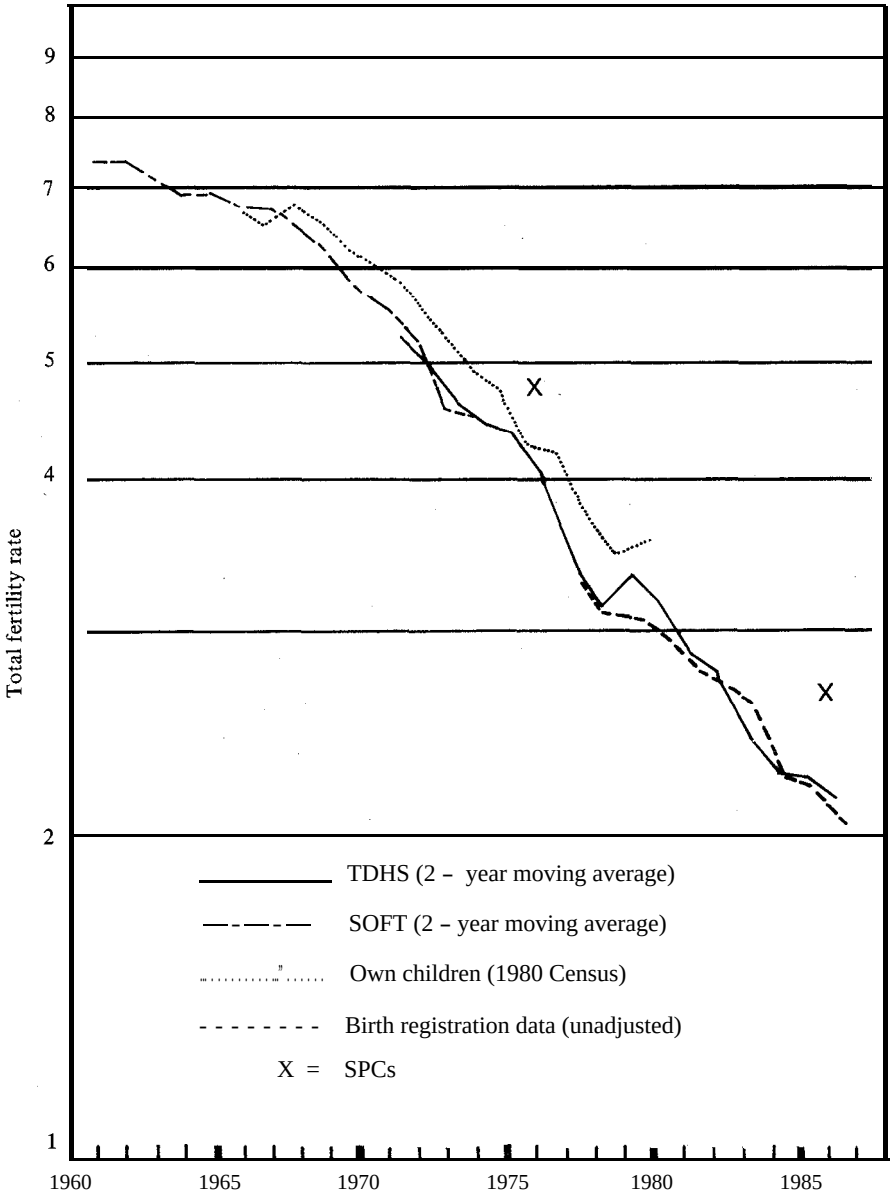

Table 3: Percentage pregnant, mean open interval and contraceptive prevalence among currently married women aged 15-44 years, from various national surveys

Year	Survey	Standardized for age*		
		Per cent pregnant	Open interval	Contraceptive prevalence
1969/70	LS1	15.3	31	15
1972/73	LS2	14.3	36	26
1975	SOFT	11.8	43	37
1978/79	CPS1	10.1**	49**	53**
1981	CPS2	9.1	51	59
1984	CPS3	8.6	56	65
1987	TDHS	7.1	62	68

Notes: * = The national age distribution of currently married women as reported in the 1970 census serves as the basis for the age standardization. LS1 and LS2 refer to the first and second rounds of the National Longitudinal Study of Social, Economic and Demographic Change.

** = Excluding the provincial urban population.

Source: Knodel, Chamratrithirong and Debavalya, 1987; and Thailand Demographic and Health Survey.

levels to some modest extent. However, there is no compelling reason in either case to expect that the possible under-reporting of births would seriously distort the trend.

Indirect evidence on fertility trends is provided by information on the percentage of women who report themselves as pregnant, the mean open birth interval and the contraceptive prevalence rate as recorded in various national surveys, including the three contraceptive prevalence surveys. All three measures are presented in table 3 for surveys covering most of the last two decades.

Since some women may not recognize or may hesitate to report an early pregnancy, the reported percentage pregnant is undoubtedly underestimated. However, if the bias is relatively constant over time, it should reflect the trend in fertility. The results presented show that the percentage pregnant declined steadily with each successive survey, including CPS2 and CPS3.

Although a straight-forward interpretation of the mean open interval, defined as the number of months since last birth, is not possible because of

the various biases to which it is subject, it has been found on a cross-national basis to show very similar rank orders to those of total fertility (Hanenberg, 1980).

The results show that the open interval increased steadily between each successive survey, including CPS2 and CPS3. In addition, contraceptive prevalence, as measured by the percentage of currently married women aged 15-44 years practising some contraceptive method, increased steadily over the same period, rising from 15 to 68 per cent. Moreover, since 1975 there has been a substantial shift towards sterilization, the most effective contraceptive method (Knodel, Chamratrithirong and Debavalya, 1987; Chayovan, Kamnuansilpa and Knodel, 1988). Thus the persistent trends towards a declining percentage pregnant, a longer open interval and a high contraceptive prevalence level are all consistent with a continuous decline in marital fertility over the period covered by the surveys.

Preferred and expected family size

Information on the number of children Thai couples prefer and the number they expect to have is useful not only for understanding the trend in fertility over the recent past but also for judging the likely level in the near-term future. Family size preferences, as indicated by responses to questions on the number of children a respondent would like to have if she could have exactly the number wanted, have been measured in various national surveys in Thailand. Table 4 summarizes the results from a number of these surveys,

Table 4: Mean preferred number of children among all currently married women aged 15-44 years and among those married fewer than five years

Year	All married women	Married fewer than five years
1972/73	3.8	3.2
1975	3.6	3.0
1979	3.3	2.8
1984	3.0	2.4*
1987	2.7	2.3*

Note: * = Refers to women aged 15-49 years.

Source: Knodel, Chamratrithirong and Debavalya, 1987; and Thailand Demographic and Health Survey.

including the recent 1987 TDHS. The mean preferred number of children is shown both for all currently married women in the reproductive ages and for those who are recently married.[7/] The latter group, defined as women married fewer than five years, is of special interest because their responses are unlikely to be affected by *ex post facto* rationalization given that most are still at too early a stage of their reproductive careers to have exceeded the number of children they would like to have. In addition, their responses are more likely than those of women whose child-bearing occurred further in the past to be indicative of the attitudes that will shape reproductive behaviour in the near future.

A parallel and substantial reduction in the mean preferred number of children is evident for both groups. The preferred number of children is consistently lower among recently married women than among all ever-married women for each survey.

This difference undoubtedly reflects some degree of rationalization and perhaps genuinely higher family size preferences among women of earlier marriage cohorts who, by virtue of longer marriage duration, are more advanced in their reproductive careers. By 1987, the preferred number of children for all ever-married women had fallen to 2.7, down from 3.8 in 1972/73, and is the lowest preferred number of children reported to date from any Thai national survey.

By comparison, women married fewer than five years in 1987 expressed a preference for an average of only 2.3 children, down from 3.2 in 1972/73 and also lower than any Thai national survey has previously indicated. When considered together with the fact that a small proportion of Thai women do not marry and presumably remain childless, current fertility preferences among recently married women imply a fertility level in the future for all women that would be very close to the replacement level.

A measure of the expected number of children can also be calculated from the TDHS and a number of earlier surveys by adding to the number of additional children each respondent indicated she wanted the number of living children she already had at the time of the survey. Although in a strict sense this measure is based on future fertility desires rather than expectations per se, the two are probably quite similar, especially in a setting such as Thailand where contraception is universally known and commonly practised. Note also that the expected number is expressed in terms of living children rather than live births since this is undoubtedly the way respondents envisage family size. This measure is less hypothetical than the preferred number of children since it is based on actual past fertility and future desires rather than on the assumption that the respondent could start child-bearing all over again.

Table 5: Preferred and expected number of children among currently married women married fewer than five years, percentage distribution and mean, 1975 and 1987

	Preferred number		Expected number	
Number	**1975**	**1987**	**1975**	**1987**
0	0	1	2	2
1	7	8	11	13
2	34	65	37	64
3	28	20	22	15
4+	31	7	28	5
Total	100	100	100	100
Mean	3.0	2.3	2.8	2.0

Note: Some percentages do not add up to 100 because of rounding.

Sources: Survey of Fertility in Thailand; and Thailand Demographic and Health Survey.

The distribution of both preferred and expected numbers of children is presented in table 5 for recently married women in 1975 and in 1987. The emergence of a consensus on small families, with a strong modal preference and expectation for two children, is clearly evident. The percentage of recently married women indicating a preference for two children increased from 34 to 65 per cent between 1975 and 1987. During the same period, the percentage preferring more than three children declined from 31 to 7 per cent. Despite the decline in the mean preferred number of children, there has been virtually no change in the percentage of recently married women who indicate a preference for fewer than two children. So far, a preference for a one-child family has yet to gain any substantial support nationally.

Changes in the distribution of the expected number of children are quite similar to those described for the preferred number of children. A massive increase between 1975 and 1987 is evident in the percentage expecting two children, accompanied by a moderate decline in the percentage expecting three and a dramatic decline in the percentage expecting more than three. While the percentage expecting fewer than two remains unchanged, it is somewhat higher in both surveys than the percentage preferring fewer than two. This probably reflects some combination of fecundity impairments and perceived economic constraints among couples with fewer than two children that prevents them from having their larger preferred number.

Gender preferences

The number of children a couple has depends not only on their preference for a particular overall family size, but also on their preference concerning the number of children of each sex that they want. In Thailand, there is considerable evidence that children of both sexes are valued and that many couples wish to have a child of each sex (Knodel, Chamratrithirong and Debavalya, 1987). Such a preference may underlie the apparent aversion to one-child families and may serve to limit the extent to which the on-going decline in fertility will continue into the future.

Results from TDHS presented in table 6 suggest that the desire to have both a son and a daughter may exert some influence on reproductive behaviour beyond the numerical preference for two children that has emerged over recent years. The results show the percentage of currently married women aged 15-44 years who do not want additional children as well as the percentage who are sterilized or whose husbands are sterilized, according to the number of living

Table 6: Percentage of currently married women aged 15-44 years who want no more children, and percentage sterilized, by age of woman and number and gender composition of living children, 1987

Number of living children and gender composition	Want no more children			Sterilized		
	15-29 years	30-44 years	Total	15-29 years	30-44 years	Total
One child						
One daughter	24	47	29	1	11	3
One son	22	45	29	0	9	3
Two children						
Two daughters	55	74	65	20	35	27
One son, one daughter	72	85	78	26	44	36
Two sons	60	81	72	26	48	39
Three children						
Three daughters	70	80	78	23	47	42
One son, two daughters	87	91	90	43	56	53
Two sons, one daughter	86	92	91	53	51	52
Three sons	59	90	80	20	54	44

Source: Thailand Demographic and Health Survey.

sons and daughters at the time of the survey. Since many couples are now practising contraception for spacing, the percentage adopting permanent methods of contraception would serve as a better indicator of a true commitment to stop child-bearing than overall contraceptive use. Given the emerging consensus for small families, results are limited to women with one, two and three living children. Results are also shown separately for younger and older women. Responses on the desire for additional children among the younger women, unlike those for older women, are unlikely to be influenced by perceived low fecundity and thus are of somewhat greater interest. In addition, the younger women will continue to exert an influence on fertility trends for a longer period into the future.

The findings generally confirm that a preference for at least one child of each sex affects reproductive desires and behaviour, especially among younger women. For example, among married women under 30 years of age with two living children, substantially more want no additional children if they already have a son and a daughter than if both children are of the same sex.

A similar pattern holds for younger women with three living children. Those with at least one child of each sex are more likely to indicate that they wish no more children than are those with children all of the same sex. Couples in which the wife is under 30 years of age with three children are also more likely to adopt a permanent method of contraception if they have a child of each sex than if all are the same sex. Several patterns in the findings suggest that there is also some son preference. In particular, couples with two children are more likely to be sterilized if they have two sons than if they have two daughters, regardless of the age of the wife.

In terms of expressed desires to stop child-bearing, only a modest proportion of younger women with one child say they wish no more children, whereas the large majority of women, regardless of age, with three children say they want no more. Nevertheless, the findings do suggest that some women may continue child-bearing beyond their preferred number of children if they do not have at least one child of each sex.

Given the apparent aversion to one-child families evident from the data on the preferred number of children as well as the existence of gender preferences, the Thai fertility decline may be close to its lower limit, at least for the foreseeable future.

Conclusions

Recent evidence from the 1987 Thailand Demographic and Health Survey in combination with fertility trends calculated from registration data clearly

contradict the impression based on the earlier series of contraceptive prevalence surveys that Thailand's fertility decline had stalled or "bottomed out" during the early 1980s. In addition, evidence on trends in the percentage pregnant, the mean open interval, and the level of contraceptive prevalence, based on a number of national surveys including the contraceptive prevalence surveys, provides further indirect support for the conclusion that fertility decline in Thailand has been largely continuous since its inception two decades or so ago.

At the same time that fertility has been declining in Thailand, family size preferences have fallen more or less steadily. A consensus had been emerging favouring a two-child family, preferably with a child of each sex. Some tolerance for having three children is evident especially if the first two children are of the same sex. Very few couples, however, are willing to have more than three regardless of sex composition. The expected family size is low among women currently starting their reproductive careers and, together with evidence on the preferred number of children, suggests that low fertility will be a feature of the Thai population for some time to come.

Footnotes

1. The Seminar on Fertility Transition in Asia: Diversity and Change, co-sponsored by the International Union for the Scientific Study of Population and the Institute of Population Studies, Chulalongkorn University, held at Bangkok, 28-31 March 1988, included papers on fertility retardation in Sri Lanka (Thapa, 1988), Malaysia (Leete and Tan Boon Ann, 1988) and the Philippines (Cabigon, 1988).

2. While full birth histories were collected in SOFT, in CPSl and CPS2 fertility estimates are based on information about the date of the respondent's last live birth and hence only rates referring to the 12-month period prior to the survey can be calculated without unduly biasing the results. In the case of CPS3, women were asked for the dates of their last two live births as well as probed to identify any more recent births that might have occurred but have not been reported because the children did not survive. This information is sufficient to calculate fertility rates for a two-year period prior to the survey. Interestingly, in both CPS3 and SOFT, when fertility rates are based on the 24 months prior to the survey, lower levels are indicated than when rates are based on only a 12-month prior period. This is the opposite of what would be expected in a situation of declining fertility. Such a pattern also appears in the results from several other national surveys in Thailand (National Research Council, 1980). Thus it probably reflects errors in reporting, recording or coding, biases in the selection of respondents actually interviewed, or some combination of these rather than a genuine rise in fertility during the two-year periods involved.

3. Age-specific fertility rates for all women can be calculated from the TDHS by incorporating information on the number of never-married women from the household questionnaire which lists all persons present in the household the night prior to the interview, according to age, sex and marital status. In brief, based on weighted data from the household questionnaire, the ratio of all women (i.e. including those never-

married) to ever-married women at each single year of age is calculated. The denominators for age-specific fertility rates are expanded by multiplying through by these ratios. Thus each ever-married woman respondent, at each single year of age, is multiplied by the ratio of all women to ever-married women at that age as determined by the household listing. The numerators of the fertility rates remain the number of births reported by the ever-married women, assuming that no births occurred among never-married women. In practice, the calculation of these multiplication factors takes into account differences in the way in which age is derived in the household listing and the individual ever-married woman questionnaire. (For further details see Chayovan, Kamnuansilpa and Knodel, 1988.)

4. The adjustments were made as follows: total fertility rates (TFR) derived directly from the birth histories collected in the TDHS were calculated for successive 12-month periods preceding the survey based on ages 15-49 for the first three prior 12-month periods (covering 1984/85-1986/87), ages 15-44 for the next five prior 12-month periods (covering 1979/80-1983/84), ages 15-39 for the next five prior 12-month periods (covering 1974/75-1978/79), and ages 15-34 for the next four prior 12-month periods (covering 1970/71-1973/74). In order to convert the "partial" total fertility rates derived from the TDHS for the years prior to 1984/85 into complete TFRs covering the entire reproductive age span 15-49 years, the ratio of the complete to the partial rate was calculated from the age-specific fertility rates from the 1980 census based on the "own children" technique and the most recent Survey of Population Change (Arnold, Pejaranonda and Choe, 1985 and the National Statistical Office, forthcoming). The partial TFR from the TDHS is then multiplied by the appropriate ratio to estimate the complete rate. In all cases these inflation factors depend only on the age pattern of fertility and not the level of fertility reported by the sources from which they are derived.

5. In the TDHS, successful contact was made with the household on the first visit 93.6 per cent of the times, and once the household was contacted and an eligible woman identified, the eligible women was interviewed at the time of first contact with the household 83.8 per cent of the time. Assuming that the percentage of times in which contact was made on the first visit for households having an eligible respondent is the same as for households overall, this implies that, in about 78 per cent of the cases (.936 x .838 x 100), an eligible respondent was interviewed on the first visit to the household.

6. The most recent SPC indicates birth registration is 88 per cent complete. This estimate, however, refers only to births actually occurring during the study period, mid-1985 to mid-1986, and does not necessarily imply the number of births registered nationally is 88 per cent of the number that actually occurred during the year. Differences can arise in at least two ways. The births reported nationally include all births registered in a given time period including births that occurred earlier but have been registered late, even if the birth registered refers to a child who is presently at school entry age or older. Unfortunately, the extent of late registration is unknown. In addition, errors that occur at the various levels of aggregation that take place prior to reporting the births to the national centre will also influence the extent to which the national figures reported for registered births in a year correspond to the actual number that occurred during that year.

7. Although the evidence on preferred number of children presented here is based on responses from ever-married women, several surveys have also included male respondents and suggest that there is little difference in family size preferences between the sexes in Thailand. (For a review of the evidence on sex differences in family size desires in Thailand as well as elsewhere, see Mason and Taj, 1987.)

References

Arnold, Fred, Chintana Pejaranonda and Minja Kim Choe (1985). Provincial level fertility estimates, 1965-79: An application of the own children method. *Subject Report* No. 4, 1980 Population and Housing Census, (Bangkok, National Statistical Office).

Bongaarts, John (1987). "The transition in reproductive behavior in the third world," in Jane Menken (ed.), *World Population and U.S. Policy*, (New York, Norton), pp. 105-132.

Cabigon, Josefina (1988). Retardation of fertility decline in the Philippines and its causes. Paper presented at the IUSSP Seminar on Fertility Transition in Asia: Diversity and Change, Bangkok, 28-31 March 1988.

Chayovan, Napaporn, Peerasit Kamnuansilpa and John Knodel (1988). *Thailand Demographic and Health Survey 1987*, (Bangkok, Institute of Population Studies, Chulalongkorn University).

Gendell, Murray (1984). Stalls in fertility decline in Costa Rica, Korea, and Sri Lanka. *World Bank Staff Working Papers*, No. 693. Population and Development Series, No. 18, (Washington, The World Bank).

Hanenberg, Robert (1980). "Current fertility," *WFS Comparative Studies*, No. 11, (Voorburg, the Netherlands, International Statistical Institute).

Kamnuansilpa, Peerasit and Aphichat Chamratrithirong (1985). *Contraceptive Use and Fertility in Thailand: Results from the 1984 Contraceptive Prevalence Survey*, (Bangkok, Research Centre, National Institute of Development Administration; Institute for Population and Social Research, Mahidol University; and National Family Planning Programme, Ministry of Public Health).

Knodel, John, Aphichat Chamratrithirong, Napaporn Chayovan and Nibhon Debavalya (1982). *Fertility in Thailand: Trends, Differentials, and Proximate Determinants*, (Washington, D.C., National Academy of Sciences).

Knodel, John, Aphichat Chamratrithirong and Nibhon Debavalya (1987). *Thailand's Reproductive Revolution*, (Madison, University of Wisconsin Press).

Leete, Richard and Tan Boon Ann (1988). Retardation of fertility decline in Malaysia and its causes. Paper presented at the IUSSP Seminar on Fertility Transition is Asia: Diversity and Change, Bangkok, 28-31 March 1988.

Mason, Karen O. and Anju M. Taj (1987). "Differences between Women's and Men's Reproductive Goals in Developing Countries," *Population and Development Review*, vol. 13, No. 4, pp. 611-638.

National Economic and Social Development Board, Working Group on Population Projections (1985). *Population Projections for Thailand, 1980-2015*, (Bangkok, National Economic and Social Development Board).

National Statistical Office (forthcoming). *The Survey of Population Change, 1985-86*, (Bangkok, National Statistical Office).

Thapa, Shyam (1988). The phenomenon of a lull in rapid fertility decline in Sri Lanka. Paper presented at the IUSSP Seminar on Fertility Transition in Asia: Diversity and Change, Bangkok, 28-31 March 1988.

van de Walle, E. and John Knodel (1980). "Europe's fertility transition: New evidence and lessons for today's developing world," *Population Bulletin*, vol. 34, No. 6.

Aging in China: Demographic Alternatives

Considerable shifts in the age structure are expected to generate a number of adjustment problems at personal and familial levels, and a vast range of socio-economic disturbances at societal and governmental levels

By Naohiro Ogawa*

As a consequence of their rapid fertility declines and pronounced mortality improvements in recent years, many of the developing countries in Asia have become increasingly aware of a number of serious aging problems (Ogawa, 1988a). More importantly, primarily because the demographic transition in these Asian countries has been substantially shorter than in the developed countries (Leete, 1987) the process of population aging in the former has

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been and will be considerably faster than that observed in the latter. China provides a salient example of fast population aging among the developing countries in Asia.

According to China's 1982 Population Census, the total population was slightly more than one billion, which corresponded to approximately 22 per cent of the world population, or 39 per cent of the population in Asia. Although China has the world's largest population, subsequent to the so-called "baby boom" during the period 1962-1970, its population growth rate declined very rapidly up to 1984; as opposed to the 1970 annual population growth rate of 2.13 per cent, by 1984 it had decreased to 1.08 per cent. Fertility reduction, which was attributable largely to the "later (marriage), longer (spacing), fewer (children)" and one-child birth limitation campaigns initiated by the Chinese Government, was a principal propellent in inducing such slower population growth. In 1970, for example, the total fertility rate (TFR) was 5.81, but it had fallen to 1.84 by 1984. This pace at which China's fertility reduction was achieved was almost as fast as that experienced by Japan during a comparable period of time (Kuroda, 1987). However, following the issuance of a document by the Party Central Committee in early 1984 which relaxed the one-child policy with the slogan "open a small hole to close up a large one", the population growth rate has been on an upward trend, reaching 1.48 per cent in 1987. In parallel with this rise in the population growth rate, TFR has also increased to 2.40 by 1987. A careful demographic analysis has shown that this recent increase in the population growth rate has been induced mainly by the change in population policy, though, to a relatively limited extent, age structural shifts have contributed to the higher population growth rate (Yan, 1988).

As regards mortality, it has improved to a considerable extent over the period 1970-1987. For instance, the crude death rate (CDR) declined from 7.6 in 1970 to 6.4 in 1987, although it has been fluctuating appreciably in the 1980s. The estimates based upon the 1982 Population Census show that in 1981 the expectation of life at birth was 66.43 years for males and 69.35 years for females.

These changes in both fertility and mortality have generated a considerable age structural transformation. According to China's 1964 Population Census, the proportion of those aged 0-14 was 40.1 per cent, and that for 65 and over, 3.5 per cent. The 1982 Population Census shows that these proportions are 33.6 per cent and 4.9 per cent, respectively.

These age structural shifts, primarily induced by the fertility reduction and secondarily by mortality improvements, are expected to generate a number of adjustment problems at personal and familial levels, and a vast range of socio-economic disturbances at societal and governmental levels. For instance, the economic and security concerns of the elderly population of China include

many aspects directly concerning older persons themselves, or either social or economic elements of society, or both personal and societal aspects. It should be noted, however, that adjustments at societal levels will be increasingly difficult due to the aging of the productive-age population itself.

To cope with these future problems on aging, a series of effective policies to modify a host of institutional and socio-economic factors is expected to be formulated and implemented by the Chinese Government in due course on a step-by-step basis.

Although China's overriding concern currently is with overall population size (Bongaarts and Greenhalgh, 1983, not only in academic circles but also among government policy makers, there has recently been an increased awareness of policy needs to handle the formidable socio-economic problems likely to arise from the aging of the population. In response to the increased awareness of policy needs, the Government of China established the China National Committee on Aging (CNCA) in 1982 as a secretariat for co-ordinating its activities related to the problems of aging in China.

As part of CNCA's research programme, an attempt was made in 1985 to prepare a set of population projections, using the total counts of the 1982 Population Census (Ogawa *et al*., 1985). Distinct from a number of China's population projections previously undertaken, these population projections placed heavy emphasis upon the pattern of future changes in the size and age structure of the elderly population with a view to shedding more light on the aging process likely to be observed in the several decades to come. Subsequent to these projection exercises, however, more up-dated estimates on fertility change have become available in the recent past. By utilizing these fertility data, therefore, a new set of population projections has been prepared.

In this article, the computational results of these new population projections will be discussed and some of the grave policy implications derived from them will be considered. In the next section, some of the major population projections for China computed in recent years will be briefly reviewed. In the section under the heading "Computational assumptions used", various assumptions employed in the new population projections will be discussed.

The section under the heading "Selected computational results" will deal with an analysis of computational results on a selective basis. In the section entitled "Sources of aging", a formal demographic tool will be applied to the projection results to identify the sources of population aging from 1987 to 2050. In the last section, some of the main findings obtained from these population projections will be highlighted for considering several implications for China's future policies on aging.

Review of population projections for China

In the past several years, a number of population projections for China have been made for various analytical and policy purposes. Because a detailed review of projections up to 1982 can be found elsewhere (Chen and Kols, 1982) this section deals with a brief review of a few selected population projections recently undertaken, and compares some of the major differences among these projections.

As part of its 1984 assessment work, the Population Division of the United Nations prepared population projections for China (United Nations, 1986). Using the 1982 Population Census as the base-line data, three projection cases over the period 1950-2025 were computed. Each of these three projections assumed a different pattern of fertility change from 1980-1985 to 2020-2025. In the medium variant case, TFR was assumed to decrease from 2.36 in 1980-1985 to 1.91 in 1990-1995, but to rise gradually to 2.11 by 2020-2025. In the high variant case, TFR was assumed to decrease from 2.80 in 1980-1985 to 2.10 in 1995-2000, after which it would remain unchanged at the latter level. The low variant case assumed that TFR would fall from 2.30 in 1980-1985 to 1.50 in 1995-2000, but increase to 1.70 by the year 2025. Regarding mortality change, life expectancy for males was assumed to improve gradually from 66.69 years during 1980-1985 to 73.02 years during 2020-2025 while life expectancy for females was considered likely to rise from 68.95 years to 78.63 years over the same time period. These changes in mortality were applied to all three projection cases.

The projected results on the total population and the proportion of those aged 65 and over are as follows:

		1980	2000	2025
High variant:	Total population (billion)	0.996	1.384	1.615
	% 65 and over	4.7	6.8	11.7
Medium variant:	Total population	0.996	1.256	1.475
	% 65 and over	4.7	7.2	12.9
Low variant:	Total population	0.996	1.208	1.302
	% 65 and over	4.7	7.5	14.6

It can easily be noted that although the three projections show fairly limited differences in both the total population size and the proportion of the elderly in the year 2000, they present marked contrasts in the final projection year. For example, the projected total population for the year 2000 is 1.256

billion in the medium variant, 1.316 billion in the high variant, and 1.208 billion in the low variant. For 2025, however, it is 1.475 billion, 1.615 billion, and 1.302 billion, respectively. With respect to the proportion of those at ages 65 and over, the medium variant shows 7.2 per cent for the year 2000 and 12.9 per cent for 2025. The high variant produces a slightly younger age structure, namely, 6.8 per cent in 2000, and 11.7 per cent in 2025; the low variant, 7.5 per cent in 2000 and 14.6 per cent in 2025.

In its *World Development Report* for 1984, the World Bank published three different population projections for China (World Bank, 1984). In the same year, King (1984) discussed a slightly modified version of these World Bank population projections. Because the description of the former is relatively sketchy and the basic results of these two sets of population projections are highly comparable, King's version of the World Bank population projections will be examined here. He considered the following four fertility paths as plausible. In Projection Bl , TFR was assumed to fall from an average of 2.3 in 1980-1985 to 1.7 after 1985 up to 2100. (This projection corresponds to the standard projection case presented in the *World Development Report* for 1984). Projection B2 follows the same fertility course as B1 until in B2 this change occurs 20 years later. In Projection A, TFR decreases from 2.4 in 1980-1985 to a replacement level of 2.2 in 2000-2005, and remains at that level thereafter. In Projection C, TFR is reduced to an average of 2.0 during 1980-1985, and 1.5 thereafter. In terms of mortality, the life expectancy at birth for both sexes combined improves from 70.6 years in 1980-1985 to 81 years in 2055-2060. These mortality changes were applied to all the projection cases.

The projected total population and the proportion of those aged 65 and over for each case can be indicated as below:

		1980	2000	2025	2050	2100
Projection A:	Total population (billion)	0.980	1.282	1.538	1.632	1.667
	% 65 and over	5.2	8.1	14.1	18.7	20.6
Projection B1 :	Total population	0.980	1.196	1.391	1.414	1.420
	% 65 and over	5.2	8.7	15.7	21.3	20.6
Projection B2:	Total population	0.980	1.196	1.310	1.268	1.208
	% 65 and over	5.2	8.7	16.6	23.8	21.0
Projection C:	Total population	0.980	1.167	1.185	1.001	0.750
	% 65 and over	4.7	8.7	18.7	29.1	21.0

These computed results show that the World Bank population projections

yield faster aging processes than the ones made by the United Nations. This is attributable to the following three factors. Firstly, as compared with the United Nations population projections, the World Bank projections used as the base data a slightly smaller total population with a slightly greater proportion of the elderly. Secondly, the latter, in general, assumed lower fertility courses than the former. Thirdly, and perhaps more importantly, the latter were based upon a faster tempo of mortality decline compared with the former.

In their recent publication, Song and his associates (1985) computed five different population projections for China over the period 1980-2080, using the 1978 population estimated on a sample basis. As compared with the population projections reviewed above, a relatively wide range of alternative fertility paths is considered in their projection work. In the case of $\beta = 3.0$, for instance, TFR is assumed to remain at a level of 3.0 as observed in 1975 for the entire projection period. The cases of $\beta = 2.3$, $\beta = 2.0$ and $\beta = 1.5$ assume that starting from 1980, TFR would be kept at 2.3, 2.0 and 1.5, respectively. TFR's level of 2.3 corresponds to the one observed in 1978, The case of $\beta = 1.0$ is based upon the assumption that TFR decreases to a level of 1.0 by 1985 and is maintained at that level for the rest of the projection period. In so far as mortality is concerned, the mean expectation of life is assumed to improve over time, i.e. 68.9 years in 1980-1985, 70.4 years in 2000-2005, 76.8 years in 2030-2035 etc. These changes in mortality show that although the pace of mortality improvements is slow in the first two decades, it accelerates after the year 2000, subsequently approaching the mortality level considered in the World Bank population projections.

The computed results on the total population and the percentage share of the population aged 65 and over can be summarized as below:

		1980	**2000**	**2025**	**2050**
$\beta = 3.0$:	Total population (billion)	0.986	1.420	2.075	2.949
	% 65 and over	5.1	6.6	10.7	15.7
$\beta = 2.3$:	Total population	0.982	1.286	1.618	1.913
	% 65 and over	5.1	7.3	13.7	22.6
$\beta = 2.0$:	Total population	0.978	1.222	1.431	1.542
	% 65 and over	5.1	7.7	15.4	27.2
$\beta = 1.5$:	Total population	0.978	1.130	1.178	1.087
	% 65 and over	5.1	8.3	18.8	37.3
$\beta = 1.0$:	Total population	0.978	1.050	0.978	0.771
	% 65 and over	5.1	9.0	22.6	52.1

Owing to the wide differences in the future fertility courses, these projected values show extremely vast differences in the pattern of population aging. These projected differences are considerably larger than those observed in the United Nations population projections or the World Bank ones. The high fertility case (β = 3.0) is expected to involve a relatively low percentage share of the elderly population, while the low fertility case (β = 1.0) yields a very high proportion of the elderly population. The difference between these cases amounts to 36.4 percentage points.

In 1983, Tian (1984) projected three different future population growth paths up to 2070, utilizing the 1978 estimated population as the base data. Unlike the population projections cited above, Tian's three population projections allow substantially more fluctuations in TFR over time, as described below.

	1985	**1990**	**1995**	**2000**	**2010**	**2030**	**2070**
High variant	2.0	2.1	2.0	1.9	2.0	2.1	2.1
Medium variant	1.8	1.7	1.6	1.5	1.5	1.7	2.1
Low variant	1.6	1.5	1.4	1.3	1.5	1.9	2.1

In the high variant case, TFR oscillates in the vicinity of the replacement level. By contrast, in the medium and low variants, TFR fluctuates considerably well below the replacement level. The fertility levels of these three cases, however, converge gradually to a replacement level of 2.1 in 2070. With regard to mortality, Tian assumed that the life expectancy observed in 1978 would continue to prevail throughout the projection period. In 1978, the life expectancy at birth for males was 66.59 years, while that for females was 70.57 years.

The projected values for the total population and the proportion of the elderly population for each variant can be presented as follows:

		1985	**2000**	**2025**	**2050**
High variant :	Total population (billion)	1.051	1.282	1.461	1.501
	% 65 and over	5.6	7.1	11.5	14.4
Medium variant:	Total population	1.048	1.211	1.231	1.066
	% 65 and over	5.6	7.5	13.8	19.8
Low variant:	Total population	1.032	1.162	1.152	0.999
	% 65 and over	5.7	7.8	14.7	20.3

Owing to the fact that Tian's three projections assumed relatively low fertility paths and no mortality improvement, the projected total populations for each selected year are on the small side compared with those for other sets of population projections discussed previously. Furthermore, despite the low fertility assumptions, Tian's three projections show a rather slow process of population aging as a result of the constant mortality condition assumed throughout the projection period.

In addition to the above four different sets of population projections for China, a few other sets of population projections have recently been undertaken for specific purposes. One of them is a new set of population projections made by Bongaarts and Greenhalgh (1985) in the recent past. The main objective of their projection work was to explore possible alternatives to the one-child policy in achieving the stated demographic goal of the Chinese Government, namely, stabilizing the population size at 1.2 billion by the year 2000. In their analysis, they have compared the projection based upon the one-child policy assumption with the projection incorporating a two-child policy altemative, the key elements of which are delayed child-bearing and spacing. Quantitatively, they have demonstrated that the alternative policy might possibly prove preferable to the one-child policy.

Along a similar line of policy interest, Keyfitz (1984) prepared a series of population projections. He assumed several future fertility courses together with a continuous improvement in mortality which would raise the mean expectation of life to a level of 72 years in two generations' time. One of the primary findings of his study was that China would have to keep the annual total number of births at 16.7 million in order to be successful in achieving its officially declared demographic target in the year 2000. Keyfitz's study also showed that if China's population could be stabilized at 1.2 billion by the turn of the century, age structural changes would be extremely drastic. For instance, although the ratio of the population aged 60 and over to the productive-age population was 9 in 1980, it would rise to a level of 32 by the year 2040.

In order to estimate China's expected level of urbanization between 1982 and 2000, Banister (1986) prepared urban-rural population projections, using the 1982 Population Census data. She assumed that TFR for rural areas would decline from 3.00 in 1982 to 1.97 in 1990 while TFR for urban areas would decrease from 1.53 to 1.26 during the same time period. Between 1990 and 2000, TFR for each area was assumed to remain at the same level as that for 1990. Expectation of life at birth for rural areas was assumed to improve from 62.42 to 67.00 years for males and from 66.03 to 72.00 years for females over the period 1982-2000. In the case of urban areas, expectation of life at birth was assumed to rise from 65.89 to 70.00 years for males and from 70.09 to 76.00 years for females during the corresponding period. In so far

as internal migration is concerned, in the medium projection, the observed migration data were used for the period 1982-1984, and from 1985 to 2000, it was assumed that 2.2 per cent of the rural population would shift to urban areas each year. The projected results may be summarized as below:

	1982	1985	1990	2000
Total				
Total population (billion)	1.008	1.042	1.092	1.200
% 6.5 and over	4.9	5.0	5.5	6.6
Urban				
Total population	0.211	0.351	0.437	0.604
% 65 and over	4.5	4.4	4.6	6.3
Rural				
Total population	0.798	0.691	0.655	0.596
% 65 and over	5.0	5.4	6.0	6.9

The total population size increases from slightly more than one billion in 1982 to 1.2 billion in 2000, thus implying that the Government's target of holding its size to 1.2 billion in the year 2000 will be achieved. China's urban population is expected to increase at 3 to 5 per cent a year. By the year 2000, approximately half of the country's population will live in cities and urban towns. More importantly, not only will the urban/rural share of the total population change, but the actual size of the rural population is expected to decline by about 14 per cent between 1985 and 2000. In addition, the proportion of those aged 65 and over will grow faster in rural areas than in urban areas. In 1982, 4.5 per cent of the urban population comprised those at ages 65 and over, whereas it was 5.0 per cent for the rural population; however, these percentages are expected to rise to 6.3 per cent and 6.9 per cent, respectively, by the year 2000. Banister has suggested on the basis of these estimates that the rapidity of China's urbanization is likely to put enormous demands on urban services and infrastructure.

As reviewed above, a number of population projections for China have been made for various purposes in the past few years. Despite the existence of many projections for China, none of them provides an ideal base for analyzing a variety of the country's population aging problems. This is primarily due the fact that although all these projections employ alternative assumptions with regard to fertility, they incorporate only a single assumption pertaining to future trends in mortality. Also, some of these population projections fail to quantify China's rapid aging processes likely to occur in the second quarter of the next century. For instance, the projections prepared by Banister cover

only the period up to the year 2000; the United Nations population projections, the period 1950-2025.

In view of the limitations of the various projections currently available, we have made a new set of population projections for China, as presented in the remainder of this article.

Computational assumptions used

China's Third Population Census conducted in July 1982 counted a total of 1,004 million persons. Because this figure represents the 1982 mid-year population, we have estimated China's population at the end of 1981 by reversing the census count by six months, using both observed fertility and mortality rates. This statistical adjustment has been made primarily because both fertility and mortality rates are measured on a calendar year basis. Based upon the population size and structure adjusted by six months, we have computed China's population by age and sex at the end of 1982 by applying both fertility and mortality rates for 1982. This projection process based upon the single calendar year approach has been repeated through the application of assigned fertility and mortality rates up to the year 2050.

It should be noted, however, that because estimates of TFR over the period 1982-1987 are available (Zeng, 1988) we have used them as the actual fertility path for the first six years of our projections. These estimated values are as follows: 2.40 for 1982, 2.20 for 1983, 1.84 for 1984, 1.93 for 1985, 2.29 for 1986 and 2.40 for 1987. Beyond 1988, the following three alternative fertility changes are assumed: FCASE 1, FCASE 2 and FCASE 3. As regards FCASE 1, TFR is assumed to decline linearly from 2.40 in 1987 to 2.1 in 2000, and remain at that level up to 2050. FCASE 2 assumes a continuous decrease in TFR from 2.40 in 1987 to 1.8 in 2000, after which TFR recovers gradually, reaching a level of 2.1 in 2050. FCASE 3, reflecting a low fertility path, assumes that after reaching a level of 1.8 in 2000, TFR remains unchanged for the rest of the projection period.

It may be noted that in these three fertility cases the two key TFR levels have been considered, i.e. 2.1 and 1.8. Obviously, TFR = 2.1 represents the population replacement level. The latter TFR level may need an explanation. According to the *One-per-Thousand-Population Fertility Sampling Survey* conducted in September 1982, the sum of the first birth and second birth TFRs is 1.786 (Xiao, Li and Wang, 1984). With the assumption that higher order births may be further reduced in China, TFR = 1.8 has been selected as a plausible case.

It should be emphasized that the three alternative fertility paths considered in this article are rather on the high side compared with those employed

in the population projections reviewed in the previous section. This is primarily because the recent pronounced rise in fertility owing to the change in population policy and the laxity in promoting family planning have been taken into account.

These assumed TFR levels are converted to age-specific fertility rates in each projection year, using the spline-type functional relationship estimated on the basis of the 1977-1981 data derived from the *One-per-Thousand-Population Fertility Sampling Survey*. (A detailed discussion on the estimation of the spline function is available elsewhere [Ogawa *et al.*, 1985]).

In so far as the mortality component is concerned, three future courses have been considered for each sex, namely, MCASE 1, MCASE 2 and MCASE 3. Based upon the 1982 Population Census, expectation of life at birth for males in 1981 has been estimated to be 66.43 years, and that for females, 69.35 years. Using these estimates as a starting point, MCASE 1, which is the case of slower mortality improvements, assumes that the same mortality level continues from 1981 to 1985. After 1985, however, expectation of life at birth for males rises to 67.5 years in 1990, 69.1 years in 2000, 70.3 years in 2025 and 71.8 years in 2050. Expectation of life at birth for females also improves gradually from 69.35 years in 1985 to 70.6 years in 1990, 72.7 years in 2000, 74.0 years in 2025 and 75.5 years in 2050.

MCASE 2 assumes a considerably faster pace of mortality improvements than MCASE 1. Expectation of life for males rises linearly from 66.43 years in 1981 to 74.54 years in 2025 and 71.45 years in 2050. Similarly, expectation of life at birth for females increases from 69.35 years in 1981 to 80.18 years in 2025 and to 82.94 years in 2050. The values for both males and females in 2025 are equivalent to those observed in Japan in 1984, whereas the values for 2050 correspond to those likely to be achieved by their Japanese counterparts in the year 2000 (Hishinuma, 1981). Moreover, these values are fairly comparable with those assumed in the population projections undertaken by the World Bank, as discussed previously.

MCASE3 assumes an even faster extension of life than MCASE2 over the period 2025-2050. Expectation of life at birth for males improves from 74.54 years in 2025 to 81.43 years in 2050. Expectation of life at birth for females grows from 80.18 years in 2025 to 88.37 years in 2050. These values for the year 2050 have been derived from one of the recent studies on Japanese mortality (Feeney, 1988). On the basis of the pattern of mortality improvements for those aged 45 and over in Japan over the period 1960-1985, Feeney has estimated that the expectation of life at birth for Japanese males during the period 2000-2004 will be 81.43 years, while it will be 88.37 years for females. These values estimated by Feeney have recently been incorporated in a large-scale demographic-economic-medical model; the computed results

have shown that the timing of achieving these mortality levels varies considerably, depending upon the health policy to be adopted by the Japanese Government (Ogawa *et al.*, 1988a). If the present health programme structure continues, these mortality levels are likely to be achieved sometime between 2025 and 2050.

The differences in the expectation of life at birth among the three mortality cases are quite substantial. In the year 2050, the difference between MCASE1 and MCASE3 amounts to 8.38 years for males and 12.87 years for females. However, the difference is considerably smaller if one compares the expectation of life at advanced ages; as displayed in table 1, the difference at age 65 is 6.37 years for males and 8.36 years for females between MCASE1 and MCASE3 in the year 2050.

One may ask how realistic these alternative mortality paths are in the context of China's future development. Expectation of life at birth for Chinese males in 1981 is comparable to that for Japanese males in 1962, while the expectation of life for Chinese females in 1981 is close to that for Japanese females in 1958. It should be recalled that expectation of life at birth for females in 1950 for Japan was 65.6 years which was 10 years lower than that for the United States of America, but this difference had disappeared by the year 1968. In the case of expectation of life at birth for males, the difference between Japan and the United States was 7.7 years in 1950, but this difference

Table 1: Expectation of life at age 65 in three alternative mortality cases for selected years

(unit: years)

	Year		
	2000	**2025**	**2050**
MCASE 1			
Males	13.37	13.63	13.99
Females	14.90	15.25	15.69
MCASE 2			
Males	13.73	15.43	17.15
Females	16.37	18.71	20.39
MCASE 3			
Males	13.73	15.43	20.36
Females	16.37	18.71	24.05

had vanished by 1962. Moreover, in many of the population projections previously prepared in various developed and developing countries, trends in mortality were under-estimated by a wide margin (Coale, 1983). Judging from these past experiences, it seems conceivable that China may catch up with Japan in terms of mortality levels in a few decades. Undoubtedly, the number of years required for China to catch up with Japan depends upon China's future health policy and pace of economic development.

In each projection, it has also been assumed that the sex ratio at birth would change linearly from 1.0847 in 1982 to 1.06 in 1990, and remain at the 1990 level thereafter. The sex ratio of 1.0847 is the value computed from China's 1982 Population Census, while that of 1.06 is the value commonly observed in most of the populations in the contemporary world. It should also be noted that none of our projections allows any variations of population growth due to international migration.

Based upon the three fertility cases and the three mortality cases, nine different population projections have been prepared. To facilitate the dicussions which will follow in the next section, however, attention will be focused mainly on four projections and the remaining projections will be referred to from time to time for comparative purposes. The four projections are as follows:

Name of projection	Fertility case	Mortality case
PROJ I	FCASE 1	MCASE 1
PROJ II	FCASE 2	MCASE 1
PROJ III	FCASE 1	MCASE 2
PROJ IV	FCASE 2	MCASE 2

Selected computational results

Changes in projected total populations

Table 2 compares the pattern of changes in the projected total populations for the four trajectories. Both PROJ I and PROJ III show a monotonic increase, having a total population size of 1.559 billion and 1.677 billion, respectively, in the year 2050. As opposed to these two population growth paths, the remaining two population projections, PROJ II and PROJ IV, are expected to undergo a decrease in the total populations sometime in the second quarter of the next century. Among the four projections presented in table 2, PROJ II, which reflects lower fertility and higher mortality, yields the smallest population size up to the year 2050, and is the first one plunging into a negative rate of population growth; it shows the peak value of 1.426 billion in 2031, and diminishes thereafter, reaching 1.391 billion in 2050.

Table 2: Comparison of projected total populations, 1982-2050

(unit: billion persons)

Year	PROJ I	PROJ II	PROJ III	PROJ IV
1982	1.013	1.013	1.013	1.013
1987	1.070	1.070	1.071	1.071
1990	1.117	1.116	1.120	1.119
1995	1.201	1.192	1.206	1.197
2000	1.275	1.253	1.283	1.260
2005	1.332	1.296	1.343	1.307
2010	1.376	1.328	1.392	1.344
2015	1.420	1.361	1.443	1.384
2020	1.466	1.393	1.498	1.424
2025	1.507	1.416	1.551	1.460
2030	1.534	1.426	1.593	1.483
2035	1.547	1.423	1.621	1.496
2040	1.553	1.414	1.643	1.503
2045	1.557	1.403	1.662	1.506
2050	1.559	1.391	1.677	1.506

The peak value for PROJ IV is 1.506 billion in 2047. Although not shown in table 2, out of the nine population projections, the case in which both FCASE1 and MCASE3 have been assumed produces the largest population, totalling 1.282 billion in 2000, 1.551 billion in 2025 and 1.734 billion in 2050. In contrast, the case with FCASE3 and MCASE1 assumed yields the smallest population, totalling 1.311 billion in 2050 with its peak value of 1.400 in 2028.

Among the four projections displayed in table 2, PROJ II and PROJ III provide the two extreme values of the projected total populations throughout the time period in question. In the year 2000, the total population for the former is 1.253 billion, and that for the latter, 1.283 billion. The difference between the two cases amounts to only 30 million. However, it grows considerably with the passage of time, i.e. 135 million in 2025 and 286 million in 2050.

It should also be mentioned that although all nine projections prepared in the present study are expected to have total populations fairly close to 1.2 billion in the year 2000, much lower fertility and/or higher mortality assumptions are needed if the targeted population size of 1.2 billion is to be achieved by the year 2000 and stabilized at this level thereafter.

Table 3 indicates changes in selected vital rates for the four population growth paths. By and large, all the projections show a downward trend in the crude birth rates (CBR) up to the 2030s, but a slight increase in CBR over the remaining time period. In the case of the crude death rates (CDR), all four projections are expected to undergo a continuous rise throughout the projection period. The rate of natural increase (RNI), which is the difference between these two vital rates, is also on a downward trend for each of the four projections. Particularly, both PROJ II and PROJ IV are expected to have negative RNIs towards the end of the projection period.

Changes in the age structure of projected populations

As presented in table 4, the percentage share of the age group 0-14 years decreases over time in each projection case. For example, although PROJ I shows the smallest reduction in the relative size of the young population aged 0-14 years, it is expected to lower the proportion from 32.88 per cent in 1982 to 19.87 per cent in 2050. PROJ IV undergoes the largest relative decline of this age group, namely, from 32.88 per cent in 1982 to 17.89 per cent in 2050.

It should also be emphasized that all the projection cases show considerable decreases in this age group not only in relative terms but also in absolute terms. A brief comparison of the projected results reveals that, although there are a few major fluctuations over time, the magnitude of decline in this age group over the entire projection period is the smallest in PROJ III which has assumed higher fertility and lower mortality, whereas it is the largest in PROJ II with the assumptions of lower fertility and higher mortality. In the case of PROJ III, the size of this age group rises from 333.0 million in 1982 to 343.4 million in 2000, but declines to 317.4 million in 2050. In PROJ II, it decreases from 330.0 million in 1982 to 321.4 million in 2000 and to 262.9 million in 2050.

It is also interesting to observe in table 4 that despite the fact that both PROJ I and PROJ III are based upon the same fertility assumption, the latter consistently produces a lower percentage share of the age group 0-14 than the former. This is attributable to the difference in the mortality assumptions between them; due to the lower mortality condition assumed, the latter yields a larger elderly population, thus reducing the relative size of the young population. The same is true of the other pair in the population projections, i.e. PROJ II and PROJ IV.

Table 3 : Vital rates of four alternative projections, 1982-2050

Year	CBR[a/]	CDR[b/]	RNI[c/]	CBR	CDR	RNI
		PROJ I			**PROJ II**	
1982	17.73	5.81	11.92	17.73	5.81	11.92
1987	20.31	6.29	14.02	20.31	6.29	14.02
1990	21.05	6.40	14.65	20.44	6.41	14.04
1995	20.49	6.54	13.95	18.90	6.57	12.33
2000	17.25	6.70	10.55	15.03	6.79	8.24
2005	14.66	7.17	7.49	13.12	7.34	5.78
2010	13.85	7.73	6.12	12.66	7.97	4.68
2015	14.78	8.33	6.45	13.51	8.65	4.86
2020	15.23	8.97	6.26	13.70	9.40	4.30
2025	14.55	9.75	4.81	12.92	10.31	2.61
2030	13.36	10.64	2.72	11.96	11.38	0.59
2035	12.78	11.62	1.16	11.69	12.54	-0.85
2040	13.08	12.52	0.56	12.19	13.64	-1.45
2045	13.60	13.15	0.45	12.80	14.43	-1.63
2050	13.70	13.43	0.27	13.00	14.84	-1.84
		PROJ III			**PROJ IV**	
1982	17.74	5.73	12.01	17.74	5.73	12.01
1987	20.36	5.98	14.37	20.36	5.98	14.37
1990	21.11	6.11	15.00	20.50	6.11	14.39
1995	20.51	6.25	14.26	18.92	6.27	12.65
2000	17.24	6.38	10.86	15.02	6.45	8.57
2005	14.65	6.59	8.06	13.10	6.73	6.37
2010	13.80	6.90	6.90	12.60	7.11	5.50
2015	14.66	7.24	7.43	13.40	7.51	5.88
2020	15.07	7.57	7.50	13.55	7.93	5.62
2025	14.35	7.97	6.39	12.73	8.43	4.30
2030	13.10	8.57	4.53	11.70	9.15	2.55
2035	12.44	9.36	3.08	11.34	10.08	1.26
2040	12.64	10.18	2.45	11.73	11.06	0.67
2045	13.05	10.91	2.14	12.22	11.95	0.28
2050	13.09	11.45	1.63	12.34	12.63	-0.29

Notes: a/ CBR = crude birth rate.
b/ CDR = crude death rate.
c/ RNI = rate of natural increase.

Table 4: Projected results on the proportion of the age group 0-14 years, 1982-2050

(unit: per cent)

Year	PROJ I	PROJ II	PROJ III	PROJ IV
1982	32.88	32.88	32.88	32.88
1987	26.87	26.87	26.86	26.86
1990	25.65	25.65	25.61	25.52
1995	26.07	25.53	25.95	25.41
2000	26.96	25.66	26.77	25.47
2005	25.30	23.33	25.02	23.13
2010	22.55	20.45	22.33	20.24
2015	20.82	19.01	20.57	18.77
2020	20.62	18.99	20.32	18.69
2025	21.16	19.41	20.77	19.02
2030	21.10	19.22	20.60	18.72
2035	20.31	18.49	19.71	17.89
2040	19.55	18.02	18.84	17.29
2045	19.45	18.23	18.61	17.36
2050	19.87	18.90	18.93	17.89

Intertemporal changes in the size of the age group 65 and over for the four projections are discussed next. As presented in table 5, all the projection cases produce marked increases in this age group in both absolute and relative terms. A few points of interest emerge from this table. Firstly, in all the cases, the number of those aged 65 and over increases monotonically. In both PROJ I and PROJ II, it grows from 50.13 million in 1982 to 88.83 million in 2000, and to 238.57 million in 2050. In the case of PROJ III and PROJ IV with lower mortality assumed, it rises from 50.17 million in 1982 to 93.69 million in 2000 and to 324.79 million in 2050. In the year 2050, the difference in the number of the elderly population between these two pairs of projections amounts to 86.22 million. It should be noted that in all four projections, China's elderly population is likely to exceed Japan's total population sometime in the 2010s. It should also be noted that, although not presented in table 5, the three projections based upon the extremely low mortality path (MCASE3) produce even more pronounced increases in the number of the elderly popula-

Table 5: Selected indices on the aging of alternative projected populations, 1982-2050

Year	(1) Population aged 65 and over (million persons)	(2) Proportion 65 and over (%)	(3) Ratio of those aged 75 and over to those 65 and over (%)
		PROJ I	
1982	50.13	4.95	28.02
1987	59.46	5.56	29.79
1990	65.70	5.88	30.54
1995	76.57	6.38	31.13
2000	88.83	6.97	31.97
2005	98.51	7.39	33.71
2010	107.04	7.78	35.97
2015	123.79	8.72	33.85
2020	153.78	10.49	29.27
2025	171.20	11.36	31.43
2030	204.95	13.36	34.18
2035	242.26	15.66	31.11
2040	262.80	16.92	35.06
2045	256.09	16.45	42.91
2050	238.57	15.30	48.37
		PROJ II	
1982	50.13	4.95	28.02
1987	59.46	5.56	29.79
1990	65.70	5.89	30.54
1995	76.57	6.42	31.13
2000	88.83	7.09	31.97
2005	98.51	7.60	33.71
2010	107.04	8.06	35.97
2015	123.79	9.10	33.85
2020	153.78	11.04	29.27
2025	171.20	12.09	31.43
2030	204.95	14.37	34.18
2035	242.26	17.02	31.11
2040	262.80	18.58	35.06
2045	256.09	18.25	42.91
2050	238.57	17.15	48.37

Table 5: (continued)

Year	(1) Population aged 65 and over (million persons)	(2) Proportion 65 and over (%)	(3) Ratio of those aged 75 and over to those 65 and over (%)
		PROJ III	
1982	50.17	4.95	28.04
1987	60.26	5.62	30.14
1990	67.20	6.00	31.29
1995	79.51	6.59	32.45
2000	93.69	7.30	33.70
2005	106.05	7.90	35.88
2010	118.08	8.48	38.69
2015	139.40	9.66	37.16
2020	175.84	11.74	32.93
2025	201.08	12.96	35.39
2030	245.50	15.42	38.75
2035	295.96	18.25	36.35
2040	330.27	20.10	40.71
2045	334.90	20.15	49.15
2050	324.79	19.36	55.52
		PROJ IV	
1982	50.17	4.95	28.04
1987	60.26	5.62	30.14
1990	67.20	6.01	31.29
1995	79.51	6.64	32.45
2000	93.69	7.43	33.70
2005	106.05	8.11	35.88
2010	118.08	8.78	38.69
2015	139.40	10.08	37.16
2020	175.84	12.34	32.93
2025	201.08	13.78	35.39
2030	245.50	16.55	38.75
2035	295.96	19.78	36.35
2040	330.27	21.98	40.71
2045	334.90	22.24	49.15
2050	324.79	21.57	55.52

tion. In these projections, the total number of those aged 65 and over is expected to rise from 50.17 million in 1982 to 374.81 million in 2050. As compared with the results for PROJ I and PROJ II, these additional three projections are expected to involve 136.24 million more elderly persons in 2050. These computational results point to the importance of China's future mortality change in determining the size of its elderly population.

Secondly, the growth rate of the elderly population varies notably among the four projections. PROJ I shows the slowest growth in the percentage share of this age group during the projection period; the proportion of those at ages 65 and over grows from 4.95 per cent in 1982 to 6.97 per cent in 2000, to 11.36 per cent in 2025 and to 15.30 per cent in 2050. In sharp contrast, PROJ IV consistently yields the fastest growth of the proportion of this age group during 1982-2050; the relative share of the elderly population increases from 4.95 per cent in 1982 to 21.57 per cent in the final year of the projection period. This is completely the opposite of what was found previously with regard to the changes in the proportion of the young population. Therefore, these results imply that among all four projections, PROJ I undergoes the least age structural transformation, while PROJ IV suffers the most striking change in age structure. Apart from the four projections listed in table 5, the projection on the basis of extremely low fertility (FCASE3) and very low mortality (MCASE3) shows an even more dramatic increase in the proportion of this age group; it is only 4.95 per cent in 1982, but grows to 7.43 per cent in 2000, to 13.78 per cent in 2025 and to 24.00 per cent in 2050. These widening differentials in the relative size of the elderly population among the various projections are attributable primarily to the differences in the mortality assumption and partly to the different fertility courses imposed upon them.

Thirdly, all four projected cases shown in table 5 reach peak values in the relative size of this age group sometime before 2050. As indicated in column 2 of table 5, the peak value for each case is as follows: 16.92 per cent in 2040 for PROJ I, 18.58 per cent in 2040 for PROJ II, 20.15 per cent in 2045 for PROJ III and 22.24 per cent in 2045 for PROJ IV. One can note from these results that the peaks for the projections with the lower mortality assumption are observed in slightly later years than those with the higher mortality assumption. In fact, the projections with the extremely low mortality assumption (MCASE3) show a continuous rise in the proportion of this age group throughout the projection period.

Compared next are the projected results on the relative share of the elderly population with a set of data derived from the 1984 United Nations population projection work. Table 6 compares the data on the proportion of those aged 65 and over in 1985 for a number of selected countries. Among the Asian countries listed in table 6, China's current level of aging is substan-

Table 6: International comparison of the proportion of those aged 65 and over in 1985

Selected Asian countries/areas		Selected Western countries	
Country/area	**Percentage of the elderly population**	**Country/area**	**Percentage of the elderly population**
Japan	10.3	Australia	10.1
Nepal	2.9	Canada	10.4
Bangladesh	3.1	United States	11.7
Philippines	3.4	Netherlands	11.8
Indonesia	3.5	Finland	12.3
Thailand	3.7	France	12.4
Malaysia	3.8	Italy	13.0
Republic of Korea	3.8	Belgium	13.4
India	4.3	Switzerland	14.0
Sri Lanka	4.6	Federal Republic of Germany	14.5
Singapore	5.2	United Kingdom	15.1
China	5.3	Norway	15.5
Hong Kong	7.6	Sweden	16.9

Source: United Nations, *World Population Prospects: Estimates and Projections as Assessed in 1984*, Population Studies, No. 98, New York, 1986; Naohiro Ogawa *et al., Jinko Keizai Iryo Moderu ni Motozuku Choki Tenbo: Feisu III (Long-term Prospects Based upon the Population-Economic-Medical Model: Phase III)*, Nihon University Population Research Institute, Tokyo, 1988.

tially higher than that for the developing countries, but considerably lower than that for Japan or Hong Kong. Our projected results also point to the possibility that China will reach Sweden's 1985 level sometime between 2030 and 2040.

Table 7 lists the percentage of the elderly population in 2025 for selected countries. Obviously, China's percentage of the elderly population in 2025 is substantially lower than any value listed in table 7. It should be emphasized, however, that sometime in the second quarter of the next century, China's

Table 7: International comparison of the proportion of those aged 65 and over in 2025

Country/area	Percentage of those aged 65 and over
Australia	15.9
United States	17.2
Hong Kong	17.5
Singapore	17.9
United Kingdom	18.7
Canada	18.8
France	19.3
Italy	19.6
Belgium	19.8
Norway	20.2
Finland	21.0
Luxembourg	21.3
Sweden	22.2
Netherlands	22.2
Federal Republic of Germany	22.5
Denmark	22.2
Switzerland	23.8
Japan	24.5

Source: Same as table 6.

level will exceed that of most of the countries included in table 7. In fact, in the case of the projection with FCASE3 and MCASE3, the proportion of China's elderly may overtake that for Japan in 2025, thus suggesting the possibility that China's population might become the world's most elderly.

It is also important to turn attention to the speed of aging. It is very likely that sometime between 1995 and 2000 China will reach an elderly population level of 7 per cent which the United Nations has arbitrarily defined as a criterion for judging whether or not a certain national population can be classified as elderly or "aged" (United Nations, 1956). Once China's popula-

Table 8: International comparison on the speed of population aging

Country	Year in which the elderly population reaches		Time required to increase from 10 to 20 per cent (year)
	10% of total population	20% of total population	
Japan	1985	2009	24
Finland	1973	2021	48
Switzerland	1958	2012	54
Netherlands	1968	2020	52
Federal Republic of Germany	1954	2010	56
Denmark	1956	2017	61
Luxembourg	1952	2022	70
Sweden	1929	2014	85

Source: Same as table 6.

tion attains this level around the turn of the century, the aging process is expected to accelerate to a pronounced extent. In the case of PROJ IV, for example, the proportion of those aged 65 and over increases from 10.08 per cent in 2015 to 20.22 per cent in 2036. The speed of this demographic transition is faster than that for any industrialized country or area in table 8. Although the pace of the aging of the Japanese population is more rapid by a great margin than that for any western European country, China's aging process, if it follows the population growth pattern indicated by PROJ IV, will be approximately 35 per cent faster than that for Japan.

It should also be noted that the proportion of those aged 75 and over in the total population aged 65 and over increases at a dramatic rate. As presented in column 3 of table 5, both PROJ I and PROJ II show a continuous increase in this ratio from 28 per cent in 1982 to 48 per cent in 2050. PROJ III and PROJ IV indicate an even faster growth, namely, from 28 per cent in 1982 to almost 56 per cent in 2050. Moreover, in the case of the projection with the assumptions of FCASE3 and MCASE3, it will be 60 per cent in the year 2050. Compared with the United Nations data for selected industrialized countries in 2025 as displayed in table 9, the results suggest the possibility that globally China might have the highest level of aging of the elderly population

Table 9: International comparison on the aging of the elderly population in 2025

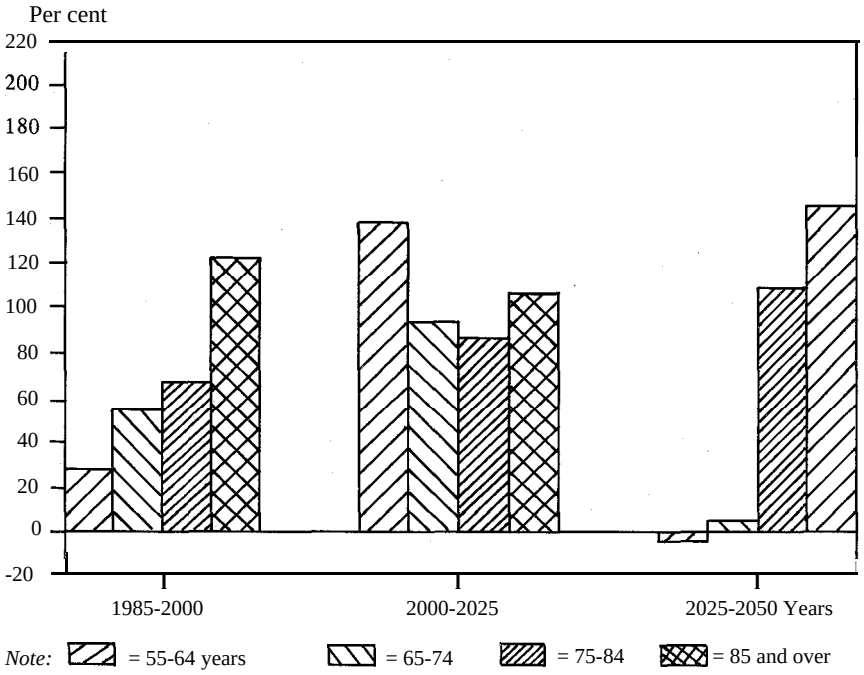
Country/area	Aged 75 and over / Aged 65 and over (per cent)
Luxembourg	38.9
Netherlands	41.4
Federal Republic of Germany	42.5
Norway	42.6
Finland	42.9
United Kingdom	43.3
Italy	43.8
Greece	44.6
Denmark	45.3
Switzerland	46.2
Sweden	47.3
Japan	53.0

Source: Same as table 6.

in the first half of the next century. It should also be noted from a policy point of view that such age compositional shifts directly affect the pattern and level of demand for medical services among the elderly. As is the case with Japan, the number of Chinese elderly persons suffering from senile dementia or who are bedridden is likely to increase at an alarming rate in the next century.

These rapid increases in the proportion of the "old-old" in the population aged 65 and over are further substantiated by data displayed in figure 1. In this graphic exposition, the intertemporal growth rates of four old age groups are compared for three selected periods, using the computed results for PROJ I which shows the slowest population aging process among the four projections. Clearly, it can be observed that the oldest age group (85 and over) is consistently the fastest growing segment of the elderly population except for the age group 55-64 during the period 2000-2025; the latter age group includes the "baby boom" cohorts born during 1962-1970. This future trend with respect to those aged 85 and over is even more pronounced for the other pro-

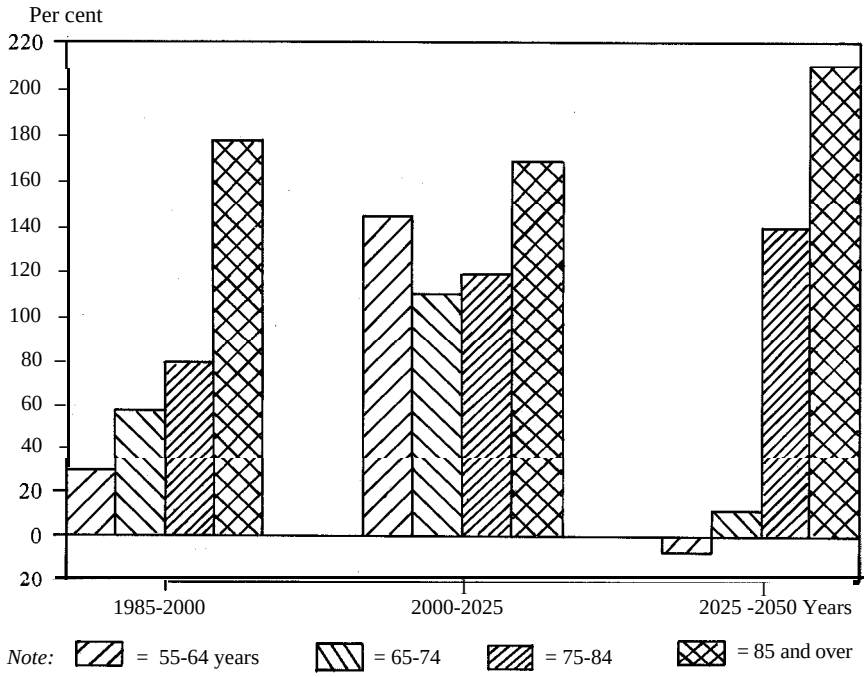
Figure 1: Intertemporal growth of the elderly population for selected age groups in PROJ I



jection cases with lower mortality conditions, as indicated in figure 2, which shows the computed results based upon PROJ IV.

There are some other features of the effect of improved mortality that merit our attention. As a result of prolonged life expectancy, an increasing share of total deaths occurring in a given year takes place at older ages. Figure 3 depicts a phenomenal rise in the proportion of deaths at ages 65 and over among all deaths from 1988 to 2050 in the two selected projection cases. In PROJ I, assuming high fertility and high mortality, it is only 50.55 per cent of all deaths in 1988, but grows to 59.71 per cent in 2000, to 67.40 per cent in 2025 and to 80.35 per cent in 2050. In PROJ IV, with low fertility and low mortality assumed, it increases from 50.75 per cent in 1988 to 89.61 per cent in 2050. Currently, nearly two thirds of all deaths occur among those aged 65 and over in developed countries, and over half of all deaths in less developed countries (Myers, 1988). In view of this general pattern, China's current level corresponds to that for developing countries, but it will approach that for developed countries by the year 2025. In addition, as this shift of the

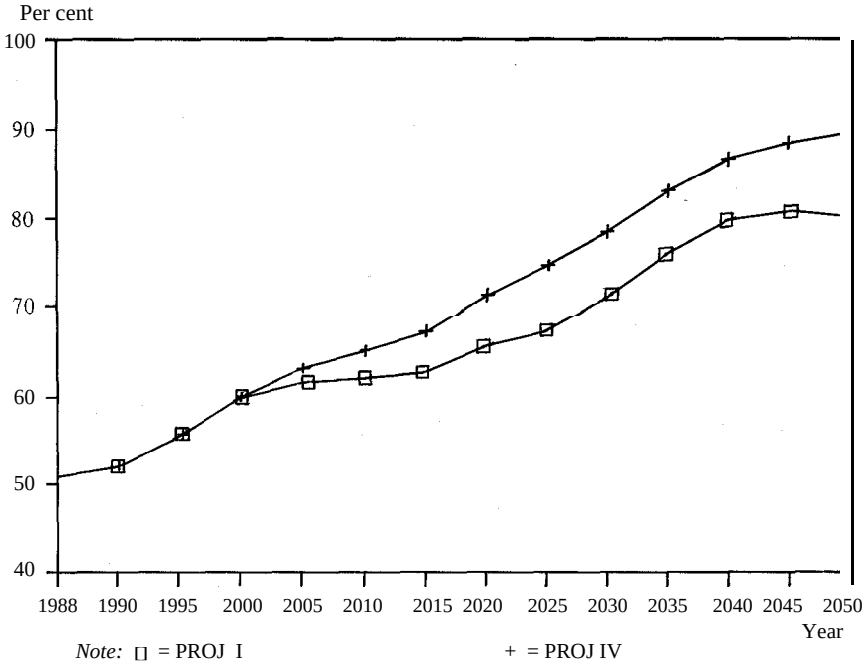
Figure 2: Intertemporal growth of the elderly population for selected age groups in PROJ IV



age composition of deaths progressively occurs, the main causes of death are likely to change; the proportion of deaths due to chronic and non-communicable diseases tends to rise at an accelerating rate, thus calling for a change in the programme for medical care services.

Another feature of mortality change is related to intertemporal changes in the sex ratio of the elderly. As a consequence of mortality differentials by sex, the predominance of women is observable at the higher ages, particularly after the age of 70, in all the projection cases. In the case of PROJ I, for example, there are only 38 men for every 100 women after the age of 90, as shown in table 10. However, the demographic feminization of the elderly becomes less pronounced over time due to a decrease in mortality differentials between men and women over time; the sex ratio for those aged 90 and over rises to 50 in the year 2000 and to 60 in the year 2050. It should be noted that in the population projections with lower mortality, the predominance of women is likely to remain more pronounced throughout the projection

Figure 3: Changes in proportion of deaths at age 65 and over in total deaths for alternative projections, 1988-2050



period. In PROJ III, the sex ratio for the age group 90 and over is 42 in the final year of the projection. This is attributable to the fact that the sex differentials of mortality diminish to a lesser extent in the low mortality case compared with the high mortality case.

The relative surplus of women at the older ages in China is also reflected in data on marital status. In 1982, the proportion of men who were married was 87 per cent for the age group 50-59, 71 per cent for those 60-79 years, and 37 per cent for those 80 years and over. The corresponding figures for women were 82 per cent, 44 per cent and 7 per cent. These data suggest that because the divorce rates are extremely low in China, the modal marital status for older women is widowhood; in 1982, 92 per cent of the women aged 80 and over were widows. It is worth noting, however, that as a result of lower mortality likely to occur in China, the joint survival of husbands and wives is expected to improve in the years to come. Despite this effect, the absolute number of elderly women will increase to a striking degree in the next century, thus leading to the rapid growth of widows in the elderly population, parti-

Table 10: Sex ratio at higher ages for four projections, 1982-2050

(unit: males per 100 females)

Year	Age					Age				
	50-59	60-69	70-79	80-89	90+	50-59	60-69	70-79	80-89	90+
	PROJ I					PROJ II				
1982	110	97	77	55	38	110	97	77	55	38
1987	111	101	81	57	39	111	101	81	57	39
1990	112	103	85	61	39	112	103	85	61	39
1995	111	105	90	69	44	111	105	90	69	44
2000	109	106	94	74	50	109	106	94	74	50
2005	106	105	95	78	56	106	105	95	78	56
2010	106	103	96	81	60	106	103	96	81	60
2015	105	101	95	81	62	104	101	95	81	62
2020	103	100	93	82	64	103	100	93	82	64
2025	103	99	91	81	64	103	99	91	81	64
2030	103	97	91	80	64	103	97	91	80	64
2035	104	97	89	78	63	104	97	89	78	63
2040	104	97	88	77	62	104	97	88	77	62
2045	102	98	88	76	60	102	98	88	76	60
2050	102	98	88	75	60	102	98	88	75	60

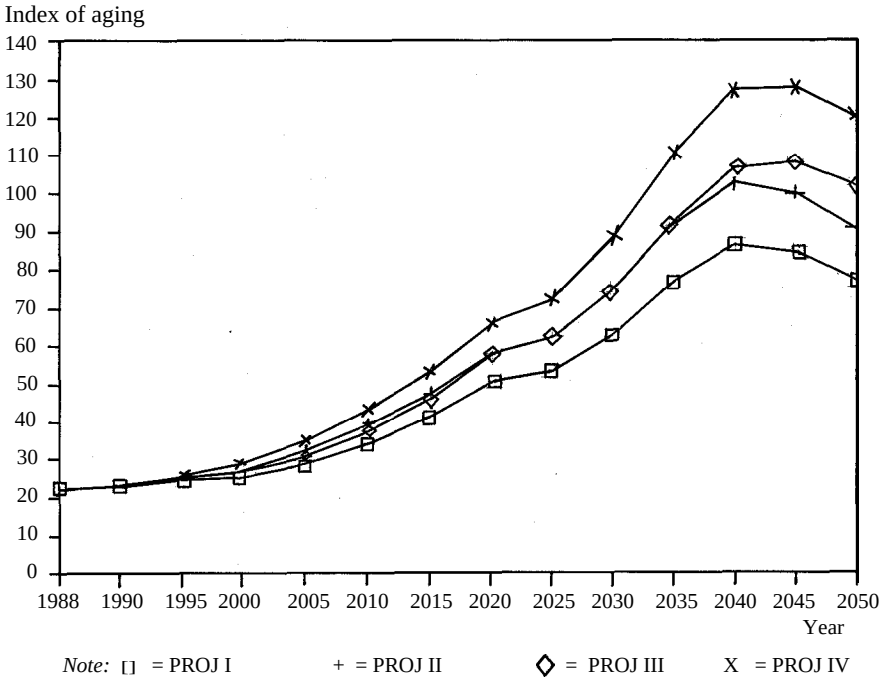
Table 10: (continued)

Year	Age					Age				
	50-59	60-69	70-79	80-89	90+	50-59	60-69	70-79	80-89	90+
	PROJ III					PROJ IV				
1982	110	97	77	55	38	110	97	77	55	38
1987	111	101	81	56	38	111	101	81	56	38
1990	111	103	83	57	38	111	103	83	57	38
1995	111	104	86	61	39	111	104	86	61	39
2000	109	105	90	63	41	109	105	90	63	41
2005	106	105	91	66	43	106	105	91	66	43
2010	105	102	91	68	45	105	101	91	68	51
2015	104	100	91	68	46	104	100	91	69	46
2020	102	99	89	69	48	102	99	89	69	48
2025	102	98	87	68	48	102	98	87	68	48
2030	102	96	86	68	47	102	96	86	68	47
2035	103	96	86	67	45	103	96	86	67	45
2040	103	97	85	67	44	103	97	85	67	44
2045	102	98	85	68	43	102	98	85	68	43
2050	101	98	86	68	42	101	98	86	68	42

cularly at the advanced ages. In view of this likely future trend, an innovative approach has recently been initiated in China; its purpose is to promote family support by creating match-making centres for the elderly in order to encourage remarriage among the widowed (Gibson, 1988). The extent to which an approach of this nature succeeds in Chinese society affects the policy for the public support system including the programme for the five guarantees (food, clothing, medical care, housing and burial expenses) in rural areas.

Figure 4 exhibits the pattern of changes in the index of aging (population aged 65 and over divided by the population aged 0 – 14 x 100) for the four projection cases over the period 1982-2050. All the cases show an extremely rapid growth of this index, particularly after the year 2000. The fastest growth pattern can be observed with regard to PROJ IV; although it is only 15.1 in 1982, it grows to 129.0 in 2043. In contrast, PROJ I, which yields the slowest growth pattern, increases the value of this index from 15.1 in 1982 to 86.8 in 2041. It is important to note that all the projection cases except for PROJ I eventually have values greater than 100. This implies that these

Figure 4: Projected values of the index of aging for four alternative population growth paths, 1988-2050



three projections indicate the possibility that China will run into a situation where elderly persons outnumber young persons. The timing of such major age compositional transformations differs considerably from projection to projection: it is the year 2038 for PROJ II and PROJ III, and 2033 for PROJ IV. Furthermore, these results for the four projections should be compared with those for the projection assuming FCASE3 and MCASE3. In this alternative projection, the index of aging rises from 15.1 in 1982 to 167.5 in 2048, which shows much faster growth of population aging. Also, the timing of the value equalling 100 is much faster than that for the four other projections: it is the year 2031.

The changes over time in the more proximate demographic factors that may influence the degree of support across generations should be examined. Because both the young and the elderly populations are generally economically unproductive, they are supported by the working population aged 15-64 years. The relative burden of the former upon the latter is conventionally measured in terms of the total dependency ratio defined as the number of dependents per 100 persons in the working-age group. Unlike this conventional index, we have computed a reciprocal of this index termed the total support ratio. Roughly speaking, this ratio represents the number of providers per consumer.

Table 11 presents intertemporal changes in this ratio for the four projection cases. In all four cases, the total support ratios are on an upward trend from 1982 to 2015, but on a downward trend after 2015. In PROJ I, it rises from 1.64 in 1982 to 2.39 in 2015, but falls to 1.74 in 2040. It should be noted, however, that between 1990 and 2000, this ratio declines continuously, reaching 1.95 in the year 2000. This downturn is caused by an increase in the number of births as the "baby boom" cohorts enter their reproductive years in the 1990s. It is also important to observe that in the projection with FCASE3 and MCASE3, the total support ratio for 2050 is 1.47, which is 20 per cent lower than that for PROJ I. The support capacity of providers varies considerably from projection to projection. These projected changes in the total support ratio suggest that should China's population follow any of the projected paths, its age structural transformation from 1982 to 2015 would provide a strong base for facilitating the rapid economic development process. Nevertheless, from 2015 onward, the relative burden of the dependents upon the working-age population increases to an immense degree, thus adversely affecting China's overall development endeavour.

Another index representing the degree of support across generations is the aging support ratio defined as the number of providers per elderly consumer. Because the aging support ratio is virtually free from fertility influences at least for 15 years, its intertemporal change is considerably different. Table

Table 11: Total support ratios for four projection cases, 1982-2050

Year	PROJ I	PROJ II	PROJ III	PROJ IV
1982	1.64	1.64	1.64	1.64
1987	2.08	2.08	2.08	2.08
1990	2.17	2.18	2.16	2.17
1995	2.08	2.13	2.07	2.12
2000	1.95	2.05	1.93	2.04
2005	2.06	2.23	2.03	2.20
2010	2.30	2.51	2.25	2.45
2015	2.39	2.56	2.31	2.47
2020	2.21	2.33	2.12	2.22
2025	2.07	2.17	1.96	2.05
2030	1.90	1.98	1.78	1.84
2035	1.78	1.82	1.63	1.65
2040	1.74	1.73	1.57	1.55
2045	1.79	1.74	1.58	1.53
2050	1.84	1.77	1.61	1.53

12 shows changes in this ratio over time for the four projection cases. In each projection case, the aging support ratio falls continuously until the 2040s. In PROJ I, it declines from 12.56 in 1982 to 9.49 in 2000, to 5.94 in 2025 and to 4.24 in 2050. In marked contrast, this ratio falls to 2.35 by 2050 in the case of the projection with FCASE3 and MCASE3, which is 45 per cent lower than that for PROJ I.

Another indicator more specifically focusing on intergenerational support are two types of familial support ratios. The Type-1 ratios presented in table 13 relate the population at ages 45-49 to persons aged 65-79. Thus, adult children are assessed in terms of a single generation of parents who would have borne them at ages 15 through 34 (Myers, 1988). In the case of PROJ I, this ratio is 1.06 in 1982, but oscillates appreciably during the next three decades. After 2015, however, it falls quite rapidly, thus suggesting that China's family support system might encounter serious difficulties in the last three decades of the projection period. Similar future trends can be observed with regard to the remaining three projection cases shown in table 12. Particularly,

Table 12: Aging support ratios for four projection cases, 1982-2050

Year	PROJ I	PROJ II	PROJ III	PROJ IV
1982	12.56	12.56	12.55	12.55
1987	12.16	12.16	12.00	12.00
1990	11.64	11.64	11.40	11.40
1995	10.59	10.59	10.23	10.23
2000	9.49	9.49	9.02	9.02
2005	9.10	9.09	8.49	8.47
2010	8.95	8.87	8.15	8.08
2015	8.08	7.90	7.22	7.06
2020	6.57	6.34	5.79	5.59
2025	5.94	5.67	5.11	4.88
2030	4.91	4.62	4.15	3.91
2035	4.09	3.79	3.40	3.15
2040	3.75	3.41	3.04	2.76
2045	3.90	3.48	3.04	2.72
2050	4.24	3.73	3.19	2.81

in PROJ IV, the Type-1 ratio for 2050 is only 0.38, as opposed to 1.08 for 2015. This implies that China's intergenerational family support capacity may deteriorate by two thirds in the 35-year period. In any case, the continuing growth among the elderly will increasingly constrain this potential pool of younger "care-givers".

Table 14 compares changes over time in the Type-2 familial support ratios for the four projection cases. The Type-2 familial support ratio examines the population aged 65-69 to those 80 years and over, in other words, two generations of older persons. In all the projection cases, the trends are strongly and almost consistently downward during the projection period. In 1982, the ratios are slightly higher than 4.0 for all the cases, but they decline to 1.08 for PROJ I and PROJ II in 2050, and to 0.70 for PROJ III and PROJ IV in the same year. In the case of the projection with FCASE3 and MCASE3, the ratio falls to 0.53 in the year 2050, which is almost one quarter of the 1982 level. These results point to an increasingly heavy burden of the growth of the "oldest-old" population upon potential older support generations at the younger ages

Table 13: Type-1 familial support ratios for four projection cases, 1982-2050

Year	PROJ I	PROJ II	PROJ III	PROJ IV
1982	1.06	1.06	1.06	1.06
1987	0.91	0.91	0.90	0.90
1990	0.87	0.87	0.86	0.86
1995	0.96	0.96	0.94	0.94
2000	1.12	1.12	1.08	1.08
2005	0.93	0.93	0.89	0.89
2010	1.18	1.18	1.10	1.10
2015	1.17	1.17	1.08	1.08
2020	0.85	0.85	0.78	0.78
2025	0.60	0.60	0.53	0.53
2030	0.45	0.45	0.39	0.39
2035	0.50	0.50	0.44	0.43
2040	0.51	0.48	0.44	0.41
2045	0.53	0.46	0.44	0.39
2050	0.54	0.47	0.44	0.38

among the elderly population. These measures are of great importance in view of recent discussions regarding the possible potential of younger older persons providing support for their own older parents (Myers, 1988).

As can be seen by inspection of table 15, the projected working-age populations for the four cases suffer pronounced decreases in numbers towards the end of the projection period. A similar pattern of changes can be observed with respect to the size of the labour force for each projection case, as presented in table 16. Note that these estimates on the labour force have been made by applying the age-sex-specific labour force participation rates derived from the 1982 Population Census to the working-age population of each projection case in each year.

In addition, it should also be emphasized that after the turn of the century, the labour force for each projection case undergoes not only slower or negative growth rates but also drastic change in its age composition. Table 17 shows changes for each case in the proportion of those aged 55 and over in

Table 14: Type-2 familial support ratios for four projection cases, 1982-2050

Year	PROJ I	PROJ II	PROJ III	PROJ IV
1982	4.08	4.08	4.07	4.07
1987	3.34	3.34	3.25	3.25
1990	3.20	3.20	3.02	3.02
1995	2.99	2.99	2.70	2.70
2000	2.88	2.88	2.51	2.51
2005	2.48	2.48	2.11	2.11
2010	2.26	2.26	1.86	1.86
2015	2.52	2.52	2.01	2.01
2020	3.15	3.15	2.42	2.42
2025	2.68	2.68	1.99	1.99
2030	2.98	2.98	2.15	2.15
2035	2.56	2.56	1.81	1.81
2040	2.31	2.31	1.54	1.54
2045	1.45	1.45	0.96	0.96
2050	1.08	1.08	0.70	0.70

Table 15: Working-age populations for four alternative projections in selected years

(unit: million persons)

Projection	Value for year 2000	Peak value	(year)	Value for year 2050
I	843	1 020	(2026)	1 011
II	843	980	(2016)	890
III	846	1 032	(2026)	1 035
IV	846	987	(2017)	912

Table 16: Comparison of projected growth paths of labour force, 1982-2050

(unit: million persons)

Year	PROJ I	PROJ II	PROJ III	PROJ IV
1982	532.8	532.8	532.8	532.8
1987	614.6	614.6	615.2	615.2
1990	654.3	654.3	655.4	655.4
1995	700.9	700.9	703.1	703.1
2000	729.4	729.4	732.4	732.4
2005	764.6	763.6	768.4	767.5
2010	805.0	798.3	810.2	803.5
2015	836.2	818.1	843.3	825.3
2020	847.6	816.9	857.5	826.8
2025	840.0	798.5	853.6	811.9
2030	835.6	783.6	853.4	801.2
2035	845.7	781.5	868.6	803.8
2040	860.2	781.5	888.7	809.1
2045	863.8	771.2	897.9	804.0
2050	854.8	752.2	893.8	789.2

the labour force. PROJ IV shows the most rapid age compositional transformation of the labour force; in 1982, only 7.43 per cent of the labour force belonged to the age group 55 and over, but the amount increases to 8.56 per cent in the year 2000 and 21.62 per cent in the year 2050. Even in the case of PROJ I, which shows the slowest age structural change among all the alternative projections, it is 8.39 per cent in 2000 and 17.31 per cent in 2050. Hence, these projected changes in the age composition of the labour force imply that China's policy emphasis needs to be shifted from the quantitative to the qualitative aspect of the question of "how many workers" to that of "what kind of workers" are expected to support an increasing number of dependents, particularly among the elderly.

Sources of aging: A formal demographic analysis

Fertility reduction induces a relative decrease in the number of young persons, thus accounting for "aging from the base". In contrast, depending

Table 17: Projected changes in the proportion of those aged 55 and over in the total labour force, 1982-2050

(unit: per cent)

Year	PROJ I	PROJ II	PROJ III	PROJ IV
1982	7.43	7.43	7.43	7.43
1987	7.53	7.53	7.57	7.57
1990	7.72	7.72	7.78	7.78
1995	7.99	7.99	8.08	8.08
2000	8.39	8.39	8.56	8.56
2005	9.33	9.34	9.58	9.60
2010	10.86	10.95	11.22	11.32
2015	11.31	11.56	11.82	12.07
2020	13.41	13.91	14.09	14.61
2025	15.82	16.64	16.73	17.59
2030	17.05	18.18	18.25	19.44
2035	16.52	17.88	18.02	19.47
2040	15.70	17.28	17.47	19.19
2045	16.38	18.27	18.39	20.47
2050	17.31	19.18	19.52	21.62

upon its pattern of improvement, mortality affects different segments of the population differently. To disentangle the effects of mortality and fertility upon the aging of the Chinese population, the following population projections have been undertaken for each of the four projections considered above:

(a) Projection of the 1987 base population up to selected years by applying the fertility rate as assumed for the corresponding period, but keeping mortality constant at the 1987 level;

(b) Projection of the same base population up to selected years by applying the mortality rate as assumed for the corresponding period, holding fertility constant at the 1987 level; and

(c) Projection of the base population up to selected years with both fertility and mortality constant at their 1987 levels.

Table 18: Changes in the aging index for PROJ III under alternative assumptions

	Time period					
	1987-2000	**1987-2010**	**1987-2020**	**1987-2030**	**1987-2040**	**1987-2050**
Index of aging						
Projection (a)	25.42	33.36	48.97	60.63	82.04	71.41
Projection (b)	25.62	33.51	49.41	60.36	82.17	75.33
Projection (c)	23.87	29.42	41.90	48.93	63.20	52.59
Contribution of each component						
Fertility	4.48	12.42	28.03	39.69	61.10	50.47
Mortality	4.68	12.57	28.47	39.42	61.23	54.39
Age structure	2.93	8.48	20.96	27.99	42.26	31.65
Residual	-5.75	-16.41	-40.64	-53.22	-79.35	-55.14

Table 18 compares the index of aging derived from these population projections for various selected periods on the basis of PROJ III. Examined first are the computed results for the period 1987-2000. The index of aging had a value of 20.94 in 1987 and 27.28 in 2000. It would have increased to 25.42 in 2000 under projection (a), to 25.62 under projection (b) and to 23.87 under projection (c). The total change in the index from 1987 to 2000 may be decomposed as follows:

$$\text{Total change} = \text{fertility component} + \text{mortality component} + \text{age structure} + \text{residual.}$$

Substituting the values of the components from table 18, we find

$$(27.28 - 20.94) = (25.42 - 20.94) + (25.62 - 20.94) + (23.87 - 20.94) + \text{residual}$$

or

$$6.34 = 4.48 + 4.68 + 2.93 + \text{residual}$$

where the residual is -5.75 in this case. This decomposition shows that both fertility and mortality contribute to China's population aging, but the mortality component (4.68) is 4.5 per cent more dominant than the fertility component (4.48) in the process of aging over the period 1987-2000.

The same computational procedure can be applied to the other time periods selected for this analysis. As shown in table 18, for the remaining periods except for 1987-2030, the mortality component is consistently more influential than the fertility component in inducing population aging; the former is 1.2 per cent more dominant than the latter for the period 1987-2010, 1.6 per cent for 1987-2020, 0.2 per cent for 1987-2040 and 7.8 per cent for 1987-2050. For the period 1988-2030, however, the fertility component is 0.7 per cent more dominant than the mortality component.

Table 19 presents computationa1 results based upon PROJ I. In contrast to the case of PROJ III, the fertility component is consistently a principal determinant of population aging in the case of slower improvements in mor-

Table 19: Changes in the aging index for PROJ I under alternative assumptions

	Time period					
	1987-2000	**1987-2010**	**1987-2020**	**1987-2030**	**1987-2040**	**1987-2050**
Index of aging						
Projection (a)	25.42	33.36	48.97	60.63	82.04	71.41
Projection (b)	24.26	30.34	43.51	51.09	66.66	56.68
Projection (c)	23.87	29.42	41.90	48.93	62.20	52.59
Contribution of each component						
Fertility	4.73	12.61	28.28	39.94	59.55	50.72
Mortality	3.57	9.74	22.82	30.40	45.97	35.99
Age structure	3.18	8.73	21.21	28.24	42.51	31.90
Residual	-6.33	-17.27	-42.15	-25.25	-82.17	-62.32

tality such as PROJ I. Because PROJ I and PROJ III are different only in terms of mortality change, these results point to the importance of mortality improvements in determining the process of population aging. .This observation is applicable when one compares the results between PROJ II and PROJ IV.

Table 20 shows projected results on the basis of PROJ IV. A careful comparison of the results in this table with those in table 18 reveals that fertility change matters to a substantial extent in the process of aging. In PROJ III and PROJ IV, both of which are based upon the same mortality assumption, the fertility paths are different; the former has the higher fertility path (FCASEl) while the latter has the lower one (FCASE2). Because of the difference in the assumption on fertility, the impact of the fertility component on population aging is more dominant than that of the mortality component for all the time periods selected. For instance, although the mortality component is 4.5 per cent more dominant than the fertility component in the case of PROJ III for the period 1982-2000, fertility is 33.5 per cent more influential than mortality in the case of PROJ IV for the same time period.

Table 20: Changes in the aging index for PROJ IV under alternative assumptions

	Time period					
	1987-2000	**1987-2010**	**1987-2020**	**1987-2030**	**1987-2040**	**1987-2050**
Index of aging						
Projection (a)	27.19	38.09	55.99	71.61	97.76	84.16
Projection (b)	25.62	33.51	49.41	60.36	82.17	75.33
Projection (c)	23.87	29.42	41.90	48.93	63.20	52.59
Contribution of each component						
Fertility	6.25	17.15	35.05	50.67	76.82	63.57
Mortality	4.68	12.57	28.47	39.42	62.23	54.74
Age structure	2.93	8.48	20.96	27.99	42.26	31.65
Residual	-5.62	-15.75	-39.37	-50.64	-75.13	-50.31

Caution should be exercised, however, in interpreting the calculated results when the residuals are large. As can be noted from tables 18, 19 and 20, the residual terms are of a considerable size in a number of cases. In spite of this qualification, we may conclude that the demographic sources of China's population aging vary substantially, depending upon the country's future fertility and mortality paths.

Further discussion and concluding remarks

In this article, China's future prospects have been discussed with regard to the aging of its population, by drawing heavily upon a new set of population projections prepared on the basis of the 1982 Population Census data. Unlike a variety of population projections for China currently available, our projections have placed heavy emphasis on the impact of improved mortality on China's aging process, by incorporating three alternative mortality assumptions.

In our projections, all the alternative cases point to the acceleration of China's population aging, particularly after the year 2000. It should also be emphasized that such acceleration processes will be considerably different, depending upon a choice of not only future fertility courses but also mortality assumptions. Our projection results suggest that there is every likelihood that China will have one of the most elderly populations in the world in the first half of the next century.

According to our projections, the size of China's elderly population will grow in the next 70 years by a factor of 4.8 to 7.5. In contrast, the young population is likely to decrease to a substantial degree owing to sustained low fertility. From a policy point of view, these age compositional shifts will call for a change of priorities and a reallocation of resources to accommodate the rapidly growing proportion of elderly people and the steady decrease of young people in the population. In the process of changing policy priorities and reallocating resources in the national economy, however, a wide range of socio-economic adjustment problems are likely to emerge in China, as has been the case with a number of contemporary industrialized countries including Japan (Ogawa, 1982; Ogawa and Suits, 1983). Issues concerning intra- and intergenerational equity in various government transfer programmes, such as old-age pensions and medical services, are a salient example of such problems.

For fully addressing most of these problems, however, national-level population projections such as the ones presented in this article are of limited use. Instead, population projections at regional and provincial levels are more desirable, primarily because the distribution of the elderly population is uneven

owing to the fact that both fertility and mortality declined earlier in the provinces along the coast and in large cities (Yang, 1988). Moreover, the accessibility and availability of social services differ substantially from region to region and between urban and rural areas. For instance, the urban elderly retired from state-owned enterprises receive free medical care services, whereas the medical care costs of all other urban elderly are paid by municipal governments. In rural areas, the problems of health care for the elderly are more serious (Goldstein and Goldstein, 1986). Although medical care services are available in the countryside, they are confined basically to primary health care, and are not free except for the elderly without children.

In addition to medical care services, old-age pensions, which are another vital component of the social support system for the elderly, are available to particular segments of the urban elderly population. In 1981, 45 per cent of urban retirees were pension recipients, as opposed to 1.5 per cent for rural retirees (Liang *et al.*, 1985 ; Wu and Xu, 1987). Because of such limited coverage in rural areas, the rural elderly continue to work as long as their physical condition permits.

Although population projections at regional or provincial levels provide a useful base for solving some of these problems, because the family is still the primary care giver in China, household projections are also needed for long-term planning for the welfare of the elderly.

The Chinese Government currently proposes the "three-in-one" support system for the elderly (Yang, 1988). Under this proposed system, the family plays a leading role in supporting the elderly, while the collective and the State serve as a supplementary care-giver through the establishment of an old-age insurance system in urban areas and the expansion of the pension system in rural areas. Whether or not the proposed system of this nature can achieve success depends upon how the family structure changes in China over time.

Although the three-generation family still remains an important family type in contemporary Chinese society, the nuclear family has recently become the dominant family form (Zeng, 1986). Laslett (1988) has recently pointed out that a fall in fertility as drastic as that occurring in China could lead to a degree of kinship attenuation and of kinship isolation which could become catastrophic for the elderly. For these reasons, more research efforts should be directed to an analysis of household formation, preferably at the regional or provincial levels. In this context, application of refined household projections such as HOMES (Household Model for Economic and Social Studies) would be an extremely instructive tool for such research endeavours (Mason, 1987; Ogawa, 1988b; Ogawa *et al.*, 1988b).

References

Banister, Judith (1986). "Urban-Rural Population Projections for China," Center for International Research Staff Paper No. 15, Washington, D.C.

Bongaarts, John, and Susan Greenhalgh (1985). "An Alternative to the One-Child Policy in China," *Population and Development Review*, vol. 11, No. 4, pp. 585-618.

Chen, Pi-Chao, and Andrienne Kols (1982). "Population and Birth Planning in the People's Republic of China," *Population Reports*, Series J, No. 25, J577-J618.

Coale, Ansley (1983). "A Reassessment of World Population Trends," *Population Bulletin of the United Nations*, No. 14, United Nations, New York, pp. 1-15.

Feeney, Griffith (1988). "The Aging of the Japanese Population: 1950-2025," NUPRI Research Paper Series, forthcoming.

Gibson, Mary Jo (1988). "Public Health and Social Policy," paper presented at the Expert Group Meeting on the Role of the Family in Care of the Elderly, Mexico City.

Goldstein, Alice, and Sidney Goldstein (1986). "The Challenge of an Aging Population: The Case of the People's Republic of China," *Research on Aging*, vol. 8, No. 2, pp. 179-199.

Hishinuma, Shigekazu (1981). "Mortality Trends in Japan and Their Possible Causes," M*edical Aspects of Mortality Statistics*, Skandia International Symposia, pp. 121-140.

Keyfitz, Nathan (1984). "The Population of China," *Scientific American*, vol. 250, No. 2, pp. 38-47.

King, Timothy (1984). "Choice of Alternative Paths to a Stationary Population: Some Economic Considerations," *Population, Resources, Environment and Development: Proceedings of the Expert Group on Population, Resources, Environment and Development, Geneva, 25-29 April 1983*, Population Studies No. 90, Department of International Economic and Social Affairs, United Nations, New York, pp. 145-173.

Kuroda, Toshio (1987). "Population Aging in Japan with Reference to China," *Asia-Pacific Population Journal*, vol. 2, No. 3, pp. 3-22.

Laslett, Peter (1988). "The Demographic Scene: An Overview," paper presented at the Sixth World Conference of the International Society on Family Law, Tokyo.

Leete, Richard (1987). "The Post Demographic Transition in East and South Asia: Similarities and Contrasts with Europe," *Population Studies*, vol. 41, No. 2, pp. 187-206.

Liang, Jersey, Edward Jow-Ching Tu, and Xiangming Chen (1985). "Population Aging in the People's Republic of China," paper presented at the Annual Meeting of the Population Association of America, Boston.

Mason, Andrew (1987). *HOMES: A Household Model for Economic and Social Studies*, Papers of the East-West Population Institute, No. 106.

Ogawa, Naohiro (1982). "Economic Implications of Japan's Aging Population: A Macro-Economic Demographic Modelling Approach," *International Labour Review*, vol. 121, No. 1, pp. 17-34.

_____ (1988a). "Population Change and the Welfare of the Aged," paper presented at the Regional Seminar on Frameworks for Population and Development Planning, United Nations ESCAP, Bangkok.

_____ (1988b). "Population Aging and Household Structural Change: An Application of HOMES to Japan," paper presented at the Sixth World Conference of the International Society on Family Law, Tokyo.

_____ and Daniel B. Suits (1983). "Retirement Policy and Japanese Workers: Some Results of An Opinion Survey," *International Labour Review*, vol. 122, No. 6, pp. 733-746.

_____ Yasuhiko Saito, Shuben Yao and Qin Xu (1985). "Population Projection for China 1985," Research Report No. 1, JOICFP, Tokyo.

_____ Makoto Kondo, Kiichiro Sato, Akira Sadahiro, Tomoko Sugihara, Daniel B. Suits, Andrew Mason and Griffith Feeney (1988a). *Jinko Keizai Iryo Moderu ni Motozuku Choki Tenbo: Feisu III (Long-term Prospects Based upon the Population-Economic-Medical Model: Phase III)*, Nihon University Population Research Institute, Tokyo.

_____ Nipon Poapongsakorn and Andrew Mason (1988b). "Population Change and the Costs of Health Care in Thailand," paper prepared for the National Economic and Social Development Board and the Asian Development Bank.

Song, Jian, Chi-Hsien Tuan and Jing-Yuan Yu (1985). *Population Control in China: Theory and Applications*, Praeger, New York.

Tian, Xue-yuan (1984). *On the Change of Population Age Structure and the Choice of Population Programme*, Social Sciences in China No. 2, Beijing.

United Nations (1956). *The Aging of Populations and Its Economic and Social Implications*, Population Studies No. 26, Department of Economic and Social Affairs, New York.

_____ (1986). *World Population Prospects: Estimates and Projections as Assessed in 1984*, Population Studies No. 98, New York.

World Bank (1984). *World Development Report 1984*, Oxford University Press.

Wu, Yuanjin, and Qin Xu (1987). "The Impact of an Aging Population on Socio-economic Development and Families in China," in *Aging China: Family, Economics, and Government Policies in Transition*, James H. Schulz and Deborah Davis-Friedmann (eds.), The Gerontological Society of America, Washington, D.C., pp. 19-35.

Xiao, Wen-Cheng, Meng-Hua Li and Li-Yeng Wang (1984). "Changes in Total Fertility Rate Since 1950s," *Analysis on China's National One-per-Thousand-Population Fertility Sampling Survey*, China Population Information Center, Beijing, pp. 62-67.

Yan, Hao (1988). "Recent Developments in China's Population Policy," Research Note No. 90, International Population Dynamics Program, The Australian National University, Canberra.

Yang, Quanhe (1988). "The Aging of China's Population: Perspectives and Implications," *Asia-Pacific Population Journal*, vol. 3, No. 1, pp. 55-74.

Zeng, Yi (1986). "Changes in Family Structure in China: A Simulation Study," *Population and Development Review*, vol. 12, No. 4, pp. 675-703.

_____ (1988). "Population Policies in China: New Challenge and Strategies," paper presented at the Sixth World Conference of the International Society on Family Law, Tokyo.

The Impact of Development Programmes on Fertility: A Framework for Analysis

An easy-to-use approach for measuring and monitoring the impact on fertility of development programmes and projects

By Warren C. Robinson and John F. Kantner*

There is a considerable body of research which strongly suggests that fertility is at least as much a socio-economic process as it is a purely biological one. Fertility is "caused" by a host of social, economic and psychological factors as well as by fecundity itself. From this it follows logically that any public sector programme which affects the socio-economic context will affect fertility, whether it is intended to do so or not.

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Most development assistance programmes clearly aim at changing the existing socio-economic context in the developing countries. Such programmes are intended to raise productivity, increase income, promote education, health and well-being. The reasoning is that if fertility is determined by those socio-economic factors, then it follows that such programmes are bound to have an impact on fertility.

This approach views the population-development assistance link as a mutually interacting relationship – that is, fertility affects development, and development affects fertility. The effect of high fertility and rapid population growth on development goals has been the focus of much investigation, at least since the time of Coale and Hoover's pioneering effort in 1958.[1/] But the notion that development programmes, other than family planning programmes as such, may affect fertility is a somewhat newer and more novel idea.

As a general theoretical or logical proposition, the interactive relationship depicted by this proposition seems undeniable.[2/] Yet the search for the precise linkages, the nature and strength of the relationship between development and fertility, has proven to be a tortuous one. Berelson suggested "thresholds" or levels of various indexes of socio-economic development at which fertility could be expected to decline based on the experience of countries already well into the transition.[3/] The Smithsonian group carried this proposition a step further and calculated elasticities such that the effect of, say, a 1 per cent change in education could be expressed as the expected percentage change in fertility.[4/] In the most ambitious effort to date, a United Nations report has suggested a very comprehensive matrix framework for analyzing 10 population variables, including fertility; 15 development indicator variables (per capita income etc.); 14 economic variables (capital stock etc.); 15 socio-cultural and exogenous variables (group structure etc.); and seven instrument variables (family planning programmes etc.).[5/] Several volumes of case studies have also been produced.[6/]

These efforts, while interesting, have not generated or led to a methodology which makes possible the "monitoring" of the interaction between fertility and development programmes. In other words, they are mostly retrospective studies of past events and are of limited usefulness in predicting future relationships or consequences.

However, another effort made in Pakistan in connection with the reorganization of the family planning-population welfare programme there presents an approach which may be useful. A special *ad hoc* working group, composed of local experts and outside consultants, was convened to make recommendations on the creation of "a population-development impact monitoring

framework". (The interest in this issue is particularly keen in Pakistan since the Population Welfare Division [which carries out family planning activities] is part of the Ministry of Planning and Development).

The authors of this article were members of that working group.[7/] In their view, the report of that working group, which was completed and submitted to the Minister of Planning and Development in August 1983,[8/] represents a modest contribution to the technical literature. This article is an expansion of the conclusions and methods of that report; the views expressed, however, are solely the responsibility of the authors.

This article is limited to a consideration of the impact on fertility of development programmes and projects. While, in principle, the monitoring framework should also be capable of studying the reverse-flow effects, i.e. the impact of fertility on development at the "micro" level, such impacts are not considered in this article. Its concern is restricted to fertility alone among all the possible demographic processes affected by development; thus, it ignores migration and mortality.

Prerequisites for the framework

There are several points which must be made in a preliminary way before proceeding.

What may be called the "modern" theory of fertility presents a relatively complex picture of social, economic-psychological and physiological factors interacting at the household level but affected also by societal, natural and even chance elements. The Davis-Blake framework, which is so well known as to need no repetition here, remains the best simple theoretical framework of those elements.[9/] Davis and Blake proposed that any cultural or structural factor affects fertility through 11 inescapable "intermediate variables" centring around intercourse, conception and parturition.

Bongaarts developed this framework much further by showing that a simple version of this "intermediate variables framework" could actually be estimated empirically and the relative strength of the variables could be determined.[10/] He recorded the 11 intermediate variables into the following "proximate" determinants: namely, marriage, contraception, abortion and lactation, which account for most of the control exercised in practice over fertility; finally, he added the notion of a "natural fertility" level towards which fertility inevitably tends in the absence of any constraint by the "proximate" determinants.

Whatever effect development programmes have on fertility must proceed through one or more of these proximate variables. Thus, raising the level of education, health, or income does not change fertility directly; raising the

level of one of them does (or may) affect, however, one of the intermediate variables which do in turn affect fertility.

The search for direct coefficients linking development programmes to fertility can proceed only through this framework. However, the proximate variables are "macro" in nature, but it is at the "micro" level that fertility occurs. This is the first important realization necessary before a useful impact-monitoring framework can be created.

A second point concerning development is equally important, namely that the impact of development programmes occurs at the project level and in particular geographic configurations. No policy or programme ever proceeds in an evenly distributed fashion in all parts of a country. For example, in the short-term, education means building schools and installing teachers to teach particular students particular subjects, at particular places and times. The link – i.e. the impact on fertility – thus must be at this specific level if any impact is to be demonstrated.

A third and final preliminary point must also be made. Monitoring the impact of development programmes necessarily implies the use of data, but available data will be very uneven. It would be beyond imagination that all the data needed will be automatically available; thus, while a data collection effort is almost certain to be involved, in general, however, only a limited new collection is feasible. Nonetheless, data considerations may be as important as conceptual ones.

Thus, the preliminary considerations would lead one to conclude that a useful, workable impact-monitoring framework must: a) connect development and fertility through the proximate variables framework, b) treat development in a disaggregated, project-specific and region-specific manner, and c) pay special attention to data requirements and build arrangements for obtaining such data on a routine basis.

The framework

Fertility variables

Davis and Blake listed 11 "intermediate" variables. Bongaarts' proximate variables represent a combining and simplifying of the 11. We have modified them further as shown in table 1. It is through these five sets of variables that social and economic change exerts an effect on fertility; and through these variables that development programmes have their impact. This becomes, in other words, a check-list of the possible fertility impacts of any given development programme.

Table 1: A modified intermediate variables approach to fertility determinants

A) Proportion of women 15-49 years of age currently married

- includes the following Davis-Blake variables:
  - (1) Female age at marriage and proportion marrying
  - (4) Excess male mortality and consequent early widowhood

B) Proportion of currently married women 15-49 years of age seeking to avoid pregnancy or live birth.

- includes the following Davis-Blake variables:
  - (5) Contraception (all methods)
  - (8) Voluntary sterilization
  - (11) Abortion

C) Proportion of currently married women 15-49 years of age in lactational amenorrhea

- includes the following Davis-Blake variable :
  - (7) Lactation

D) Proportion of currently married women 15-49 years of age suffering nutrition-connected or other impairments to fecundity

- includes the following Davis-Blake variables:
  - (6) Sterility
  - (7) Foetal wastage and still-births
  - (9) Age at menarche and menopause

E) Social structural factors affecting fertility apart from all other factors

- includes the following Davis-Blake variables:
  - (2) Taboos on intercourse, frequent separation of couples etc.
  - (3) Sanctions on sexual activity outside marriage

Table 2: The fertility-development programme interaction matrix

FERTILITY DETERMINANTS (using the 11 Davis-Blake variables)	PROGRAMMES								
	Direct					Indirect			
	Supplying contraception	Promoting favourable attitudes	Increasing motivation	Promoting breast-feeding	Increasing female age at marriage	Increasing health, nutrition and education	Increasing income, productivity and technology	Social change via income redistribution, land reform etc.
(B_1) Current birth limitation practices *(5) Contraception* *(8) Sterilization* *(11) Abortion*								
(B_2) Attitudes								
(B_3) Motivation								
(C) Current breast-feeding practices *(7) Lactation*								
(A) Current marriage practices *(1) Female age at marriage* *(4) Widowhood or divorce*								
(E) Social structure practices *(2) Factors affecting coital frequency* *(3) Sexual activity outside marriage*								
(D) Health and nutritional practices *(6) Sterility* *(7) Foetal wastage and still-birth* *(9) Age at menarche and menopause*								

Programme variables

All development programmes can affect fertility, but not all do so through the same links or channels. Programmes and policies can be categorized according to how they are likely to affect fertility – directly or indirectly. Thus, the check-list to be used need not be the same for all programmes. It is proposed, therefore, that all development programmes may be categorized according to their likely effect on fertility:

- **Direct effects** which aim at:
  - increasing the availability of contraception, voluntary sterilization and/or menstural regulation;
  - increasing the use of contraception, voluntary sterilization and/or menstural regulation; and
  - decreasing exposure to pregnancy by promoting increased breastfeeding, and increasing the age at marriage for women.

- **Indirect effects** which aim at:
  - improving the health, nutrition and well-being of the people;
  - increasing the income, productivity and technological base of the society; and
  - effecting social change such as income redistribution, land reform or other fundamental structural changes.

The interaction framework

The above programme effects are related to the fertility determinants as shown in the matrix presented in table 2. The modified proximate determinants framework outlined above lists five categories of fertility determinants. One of these is of key importance, i.e. the proportion of women practising contraception. Nearly all *direct* action programmes undertaken by the public sector aim at this determinant. However, it is a somewhat more complicated variable than the list presented in table 2 would suggest. The prevalence of contraception usually is measured as the sheer proportion of "eligible" women (currently married, aged 15 to 49 years) who indicate that they are currently practising some method of contraception. This ignores the important programme question of *why* they are practising contraception.

This question is important for programme assessment since at any moment several programmes may be under way which aim at increasing prevalence. For example, change in prevalence may be due to: a) supplying contraceptives when they were not previously available, b) increasing people's

Table 3: Variables to be measured

SOURCES OF DATA	Contraceptive prevalence (including sterilization)	Attitudes and motivation of users and non-users	Breast-feeding practices	Incidence of abortion	Female age at marriage and proportion currently married	Female health, nutritional status and education	Coital frequency	Fertility
Routine collection of events as they occur								
(1) Population register								
(2) Vital events registration								
(3) Programme acceptors/ users								
(4) Contraceptives distributed								
Occasional large-scale collection efforts								
(5) Population census								
(6) KAP/PFS surveys								
(7) Prevalence surveys								
Special purpose localized surveys and studies								
(8) Client follow-up studies								
(9) Small-area KAP/PFS studies								
(10) Community-level surveys								
(11) Local socio-economic studies								

awareness of the various methods and overcoming fears and uncertainties concerning their use so as to create a favourable attitude and c) motivating persons through the use of incentives and/or disincentives to practise contraception. All three of these factors are subsumed under contraceptive usage in table 2, but we separate them out in the determinants list and under "direct programme" effects.

The other direct measures include several programmes usually not considered as important in most less developed countries (LDCs); they are the increasing of the incidence of breast-feeding and the promotion of increases in the female age at marriage. Yet these factors are as direct and short-term in their effects as contraception. Including them so prominently in the matrix may serve a useful purpose by reminding policy makers of these programme options.

The *indirect* programme measures cover virtually all other development efforts. In view of the present state of knowledge about these linkages, it is not possible to make more than educated guesses about which fertility variables are likely to be related to which of these indirect programme interventions. Indeed, one important advantage of the framework is that it should make it easier to focus on these linkages and to see what data are needed to develop actual coefficients of relationship.

The matrix presented as table 2 provides a guide to where impacts on fertility (by the several sorts of programme) can be established empirically using this guide. By listing and measuring a given set of programmes in a disaggregated, project- and area-specific way, it is at once established which columns are relevant. Estimates of all the fertility-determining variables shown as row headings must also be available, both for those areas particularly affected by the programme-projects and also for areas not affected by the programme-projects.

With observations for a reasonably large number of units, e.g. districts, the isolation of the "pure" impact of the programme-projects on the fertility determinants becomes a straight-forward problem in multivariate statistical analysis. Analysis can be conducted for all such areas for which there is an impact, for a sample of such areas chosen as representative, or for only a few selected "case studies". The choice among the three approaches would be decided partly on the basis of the amount of funding which is required to achieve a certain level of analytical precision.

Another point emerges from consideration of the table. The *indirect programmes* are those which are more likely, but not necessarily, longer-term in their impact. Thus, the normal expectation is that increasing education,

income, health and so on will not affect fertility determinants at once, but only after a lag. In the case of these programmes also, the key determinant that the programmes will affect will probably be the practice of contraception. More particularly, these indirect programmes will affect contraception, if at all, through attitudes and motivation. Since attitudes and motivation are explicit, direct programme activities, it might be more precise conceptually to picture the indirect programme effects as working through the direct programme effects. However, such an approach would complicate the analytical framework and add nothing to the overall explanation.

Data requirements and sources

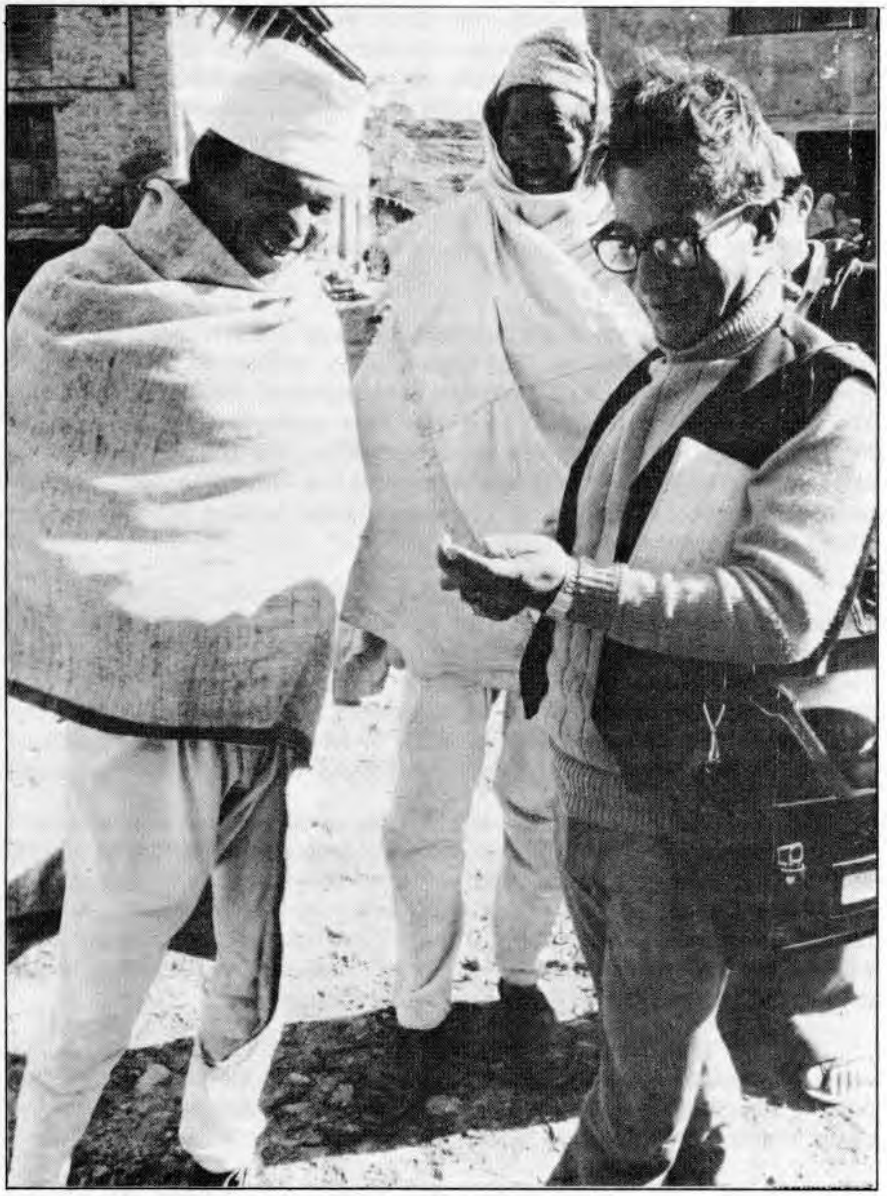
The goal is to be able to quantify the above framework, which requires quantifying the fertility and programme variables. The programme (project) variables may be assumed to be readily quantifiable; the size of any given project's budget, the time and manner in which it is spent are known for other purposes. The fertility variables are more problematic. Table 3 presents a matrix of sources against the fertility variables which must be measured to implement the framework of table 2.

The five main categories of fertility determinants arrived at above are shown as the categories, which, plus fertility itself, are the variables to be measured. The data with which the measurement must be attempted are grouped into these categories with respect to how the data are collected.

Firstly, there is the *routine collection of events* as they occur so that all (or nearly all) such "events" are regularly recorded without the need for any special *ad hoc* effort. Such data permit an analysis on a detailed geographical breakdown and also permit a close monitoring of trends over time. The only problem perhaps with such data is the sheer bulk and magnitude of the recording, storing, processing and tabulation functions and the consequent time delay in receiving results.

Secondly, there are *occasional national data collection efforts*, which are best typified by a census of population and housing, whether on a regular, or more episodic and infrequent basis. Censuses are usually on a recurrent, decennial basis; household employment and expenditure surveys, every two to five years and knowledge, attitudes and practice (KAP)-demographic surveys, on an "as required" basis.

Among the data collection procedures shown in table 3 is the third type, i.e. special purpose, localized *ad hoc surveys and studies*. These deal with particular groups of persons sharing some special characteristic which would be of interest for programme analysis. For example, a sample of family



Among the various means of collecting data are special purpose ad hoc surveys such as the one being carried out in Nepal by this family planning worker. (Photograph courtesy of IPPF)

planning clients may be selected from client records and followed up for detailed information on contraceptive experience, drop-out rates etc. Also, a particular geographical area, strongly affected by a particular development project, may be surveyed to determine any possible impact. Other, similar cases may be imagined.

In contrast with formal studies and surveys, these *ad hoc* undertakings are typically smaller in coverage and size, more limited in scope and objective, less elaborate in design and structure, and easier to undertake and complete in a timely fashion.

The three categories distinguished in table 3 differ with respect to frequency, size and coverage. The first category collects all the events of a given sort as recorded in a permanent governmental measurement system. The second collects, nationally, all units of a particular kind, or a sample thereof, through an occasional data collection effort. The 100 per cent coverage surveys (censuses) obtain less detailed information from each unit, but they obtain it from more units; the samples get more detailed information, but from a smaller number of units.

There are no clearly fixed rules for the third category of data source. Client follow-ups may be done regularly or only occasionally for all clients of a given family welfare centre, or for a sample of such clients; for all such centres, or only a sample thereof. The same applies to hosehold KAF/fertility surveys undertaken in areas where there has been an impact. In addition, these data sources may be categorized according to whether the data are collected only for the purpose of fertility-development impact monitoring and assessment.

In the first category, the data relating to *programme acceptors/users* and the *contraceptives* they use, serve only programme purposes. The population register and vital registration systems serve important demographic measurement goals, but also other social and economic purposes as well. In the second category, the censuses of population also serve multiple purposes, whereas the KAP demographic survey source yields an output related, almost exclusively, to population and development planning goals.

To the third category belong the studies which are tailor-made to the needs of assessing impact. Thus, these data collection methods have the important advantage of being completely at the behest and under the control of the population development monitoring authorities.

One can now identify a minimum required combination of data sets and sources necessary for impact evaluation and assessment of population and development, and interactions. The eight columns in table 3 identify key areas in which development impact would be looked for.

Estimates of fertility itself

The dependent variable for our assessment or impact analysis must be obtained on a regular (recurrent, but not necessarily annual) basis for the country as whole, provincial, rural and urban components thereof. Over the longer term, serious efforts should be considered for creating a population register-cum-vital statistics registration system capable of producing reliable birth-rate data.

For the short term, these macro-level fertility estimates must be generated by recurrent re-runs of a basic fertility survey on the model of the World Fertility Survey, for example. These should occur at five-year intervals using the same basic instrument and sample design. The instrument used must be a fairly detailed module dealing with contraceptive practice, socio-economic characteristics, marriage and fertility history and other elements. It thus lends itself to measurement of most causes of fertility as well as fertility itself.

Fertility also must be measured and monitored at a lower level of aggregation. As has been shown, development projects are often specific to a limited geographical area or areas. When a project has been identified as one likely to have important fertility impact, such as those described in the previous sections, there must be provision for fertility surveys of the area on a recurrent basis during the project period.

Such surveys will be much less detailed than the country-wide survey called for above. They should contain a limited number of questions, be based on as small a sample as will yield meaningful results and be designed for easy coding, tabulation and interpretation. Whenever possible, the surveys in question should be an actual part of whatever other evaluation procedure the projects have adopted. But they must by designed, supervised and interpreted by trained population analysts.

Estimates of contraceptive prevalence

There are several approaches to the estimation of contraceptive prevalence (including sterilization):

- *Contraceptive prevalence*

  The recurrent national fertility surveys can collect contraceptive prevalence data and provide benchmark estimates for national, provincial, rural and urban areas.

  Contraceptive use prevalence surveys can yield estimates for national, provincial, rural and urban, and perhaps district areas as well. These should be undertaken on a regular (annual, if possible) basis.

The service statistics of the programme itself can yield estimates of contraceptive use when combined with areal population estimates from the census or from registration data, if available) and from areal estimates obtained from special surveys undertaken in programme areas.

Special small-scale surveys in the impact areas can also yield data on contraceptive prevalence.

- *Attitudes and motivation.* Data obtained from the five-year benchmark surveys, prevalence surveys and small-scale surveys in the impact areas may include items on attitudes and motivation. These items are available in standardized modules.

- *Age at marriage and proportion currently married.* Census data, registration data (where available) and occasional surveys typically provide data on marital status and, frequently, on age at marriage as well. (It is useful to be able to distinguish first marriages from remarriages).

- *Abortion.* Hospital admissions and special occasional surveys are sources for estimating abortion; however, these data are among the most difficult to collect of any social data. For this reason, indirect, non-intrusive procedures have been developed which can provide estimates of abortion at various levels of aggregation while avoiding individual disclosure.

- *Breast-feeding.* The preferred source for data on breast-feeding is the periodic fertility survey. These data should be routinely included in such surveys, since breast-feeding, a major influence on fertility in populations with a low prevalence of contraception, is highly vulnerable to social and economic change and thus should be monitored frequently.

- *Coital fequency.* Fertility surveys may include questions on frequency of intercourse over some defined interval along with indirect questions bearing on reasons for long or frequent separations of spouses. The question typically is addressed to the female respondent.

- *Female health and nutritional status.* Fecundability, foetal wastage and the length of the reproductive age span are all affected by a woman's health status. Appropriate data are difficult to obtain routinely except for the qualitative indicators yielded by hospital records, or by data from special groups and projects. Nutrition and health surveys are becoming more common and occasionally yield benchmark estimates. Estimates of health and nutritional status can some-

times be obtained from adding a question or two to a general fertility survey.

It is fairly easy to obtain estimates of the above variables for a country as a whole and this is important as a basis for observing the areal variations in the variables due to the impact of the development programmes and projects.

At the village, regional or project-area level, more reliance must be placed on selected, special purpose socio-economic surveys and local community studies. In many cases, local studies are already being conducted, but these must be put in a framework which lends itself to systematic analysis of the relationship to the particular proximate determinants and to fertility itself.

In summary, the following comprise the data needs for most countries: a) a recurrent series of benchmark fertility surveys for the national, provincial and rural versus urban areas; b) a recurrent (annual) series of brief prevalence surveys yielding estimates to the district level; c) special purpose surveys, in particular on impact areas, using modestly framed instruments, small samples and simple analytical procedures; d) a systematic inclusion in important project evaluation instruments and procedures of a fertility/KAP module; e) systematic construction of socio-economic profiles using all available official data on impact areas and areas covered by development projects; and f) a serious effort to upgrade the vital registration system over the longer term.

Summary

This article outlines a framework for measuring and monitoring over time the impact of development programmes and projects on fertility. In our judgement, previous efforts to create such a framework have floundered by failing to specify precisely the determinants of fertility through which programmes and projects must make an impact on fertility. Similarly, programme effects become more measurable when they are divided into direct and indirect effects and when they are analyzed at the project area level. We have also shown that the data requirements for such a framework are not unreasonably large. Most countries already collect many of the data this framework requires, and modest additions to existing data collection efforts can supply missing data.

We hope that this framework provides a beginning, a general approach, which can be modified as needed for local circumstances and problems. The important thing is to make that start and, through experience and practice, develop a workable system.

Footnotes

1. Ansley J. Coale and Edgar M. Hoover, *Population Growth and Development in Low-Income Countries*, (Princeton, Princeton University Press, 1958). For a review of other later works in this genre, see Geoffrey McNicoll, "Consequences of Rapid Population Growth: An overview and assessment", *Population and Development Review*, vol. 10, No. 2, 1984, pp. 177-240.
2. For general statements of this underlying logic, see Ghazi M. Farooq, "Population, human resources and development planning: towards an integrated approach", *International Labor Review*, vol. 120, No. 3, May-June, 1981, pp. 335-349; also: Population Crisis Committee, "Accelerating Fertility Declines: Policy Alternatives", *Population*, No. 12, August 1981.
3. Bernard Berelson, "Prospects and Programs for Fertility Reduction: What? Where?", *Population and Development Review*, vol. 4, No. 4, December 1978, pp. 378-395.
4. Smithsonian Institution, Interdisciplinary Communications Program, Occasional Monograph Series, No. 2, *The Policy Relevance of Recent Social Science Research on Fertility*, (Washington, D.C., The Smithsonian Institution, September 1974).
5. United Nations, Department of International Economic and Social Affairs, Population Division, *The Work of the Task Force on Inter-Relationships Between Population and Development* (ESA/P/WP 76), November 1981.
6. Robin Barlow (ed.) *Case Studies in the Demographic Impact of Asian Development Projects* (Ann Arbor, Center for Research on Economic Development, 1982); Richard E. Bilsborrow and Pamela F. Delargy (eds.) *Impact of Rural Development Projects on Fertility*, Population Studies No. 9, (New York, United Nations Fund for Population Activities, 1985); and John Stoeckel and Anrudh K. Jain (eds.) *Fertility in Asia: Assessing the Impact of Development Projects*, (London, Frances Pinter, 1986).
7. Other members of the Working Group were: Karol J. Krothi, Jamilla Naem, Abdul Razzaque Rukanuddin and M.S. Jillani.
8. "Report of the Working Group on Population-Development Impact Monitoring Framework" submitted to the Minister for Planning and Development, Islamabad, 10 August 1983.
9. Kingsley Davis and Judith Blake, "Social Structure and Fertility: An Analytical Framework", *Economic Development and Cultural Change*, vol. 4, No. 3, April 1956, pp. 211-235.
10. John Bongaarts, "The Proximate Determinants of Fertility", *Population and Development Review*, vol. 4, No. 3, August 1978, pp. 105-132.

Correction

J.R. Rele, author of the article entitled "70 Years of Fertility Change in Korea: New Estimates from 1916 to 1985", which was published in the June 1988 issue of the *Journal* (vol. 3, No. 2), would like to make the following corrections:

Page	Location	As printed	Correction
33	Table 1, col. 1	C (0-4)	C (0-4)
		W (15-49)	W (15-49)
		C (5-9)	C (5-9)
		W (20-54)	W (20-54)
36	Table 2, Row 1944, Col. CWR 1 x 1000	722	772
47	Line 9	. . . provinces in	. . . provinces is

Population and Development

Over the past decade, population issues have been increasingly recognized as a fundamental element of development planning and that, to be realistic, development activities must reflect the inextricable links between population and development.

The first recommendation of the International Conference on Population, which was held at Mexico City during 1984, states that national development policies, plans and programmes as well as international development strategies should be formulated on the basis of an integrated approach that takes into account the interrelationships between population and development. Also, the Asia-Pacific Call for Action on Population and Development, which was issued by the Third Asian and Pacific Population Conference at Colombo, Sri Lanka in 1982, urged that Governments undertake periodic reviews and appraisals of the progress made in achieving the objectives of the Call for Action.

For these reasons, the secretariat of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) organized the Ad Hoc Expert Group Meeting on the Integration of Population and Development Policies from 29 August to 2 September 1988 at Bangkok. The objectives of the meeting were to develop methodologies for the review, appraisal and analysis of the progress made in achieving the objectives of the Asia-Pacific Call for Action, and to develop guidelines for the further implementation of the recommendations of that Call for Action.

Participants were from Bangladesh, China, India, Indonesia, Malaysia, Nepal, Pakistan, Philippines, Thailand and Viet Nam as well as the Food and Agriculture Organization of the United Nations, the International Labour Organisation, the United Nations Population Fund and the World Health Organization.

While there has been considerable progress in all countries of the Asian and Pacific region in creating an institutional infrastructure to assist in the integration of population and development planning, specialized population units created to ensure integration have been hampered by a lack of funds, trained manpower, adequate data for planning, and control over plans submitted to other ministries.

One of the recommendations of the Call for Action urged countries and areas of the region to attain replacement level fertility by the year 2000. This goal has been achieved in Hong Kong, the Republic of Korea and Singapore and apparently will be comfortably achieved in China and Thailand. However, in most other countries in the region the goal will not be achieved until a decade or two after the turn of the century, according to the most recent population projections prepared by the United Nations. The current policy in Malaysia is to lower fertility gradually to the replacement level in the year 2070.

The Call for Action also established the goals of a minimum expectation of life at birth of 55 years and an infant mortality rate of less than 100, to be achieved by the end of the 1980s. Although the data base for measuring the achievement of these goals is weak, United Nations projections indicate that at least seven countries in the region will fail to achieve the targets.

The Asia-Pacific Call for Action also made recommendations related to migration, urbanization, status and role of women, children and youth, the elderly, population data and information, and training and manpower development; the meeting devoted considerable attention to these topics. Many experts at the meeting reported on institutional arrangements made to assist the integration of population and development policies and planning, and on the achievement of lower fertility and mortality in countries of the region.

The meeting urged that more attention be given to policies to influence migration, urbanization and spatial distribution of population.

Since the Third Asian and Pacific Population Conference in 1982, many countries in the region have shifted the emphasis of their population programme to some extent from a concern with numerical targets to a concern with the quality of population. Population is increasingly being considered

a resource rather than a liability for national development. As a consequence, Governments are continuing to improve the educational and health standards of their population.

The stress on human resources has led to an increased awareness of the importance of women in achieving population and development goals. A concern with the quality of life of the population has drawn attention to environmental issues associated with population size and growth. As a result, many countries in the region have taken action to integrate environmental issues with development in order to provide for sustainable development.

The meeting considered issues relating to the institutional framework for integration of population and development planning, a working document focusing on one major national programme and issues relating to policy formulation and implementation in the context of strategies to strengthen the integration of population and development policies, population data, research and information support, training and manpower development, and monitoring and evaluation.

The meeting also considered population and development policies in least developed economies and suggestions for the further implementation of the recommendations of the Asia-Pacific Call for Action on Population and Development.

The report of the meeting is available from ESCAP on request.

Mr. Koji Nakagawa (left), ESCAP Deputy Executive Secretary, inaugurates the Ad Hoc Expert Group Meeting on Integration of Population and Development Policies, which was held at the secretariat from 29 August to 2 September 1988. The Chairman of the meeting, Mr. A.K.M. Ghulam Rabbani of Bangladesh and Mr. Abdus Samad, Chief, General Demography Section, look on.